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PUBLIC SERVICE STATISTICS IN THE UNITED STATES.*

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In discussing the development of public service statistics in the United States, I purpose, first, to describe the growth of such statistics in the United States and their status and extent at the present time; second, to discuss the defects that seem to stand out most prominently; finally, to suggest what function, if any, the American Statistical Association and its members may have in the work of remedy and improvement.

Turning first to the definition of *public service*, in its broadest application it comprises all activity that has within it the nature or aspect of a public calling. In this aspect any corporation catering to the public is a public service corporation, as a manufacturing company, or a trading company, or a corporation engaged in commerce or finance. In a narrower application the public service category covers the efforts of all individuals or corporations serving the public in a general capacity, as for example a horse doctor, a smith, an innkeeper, a public entertainer, a theatrical company, or a warehouse corporation. In the generally accepted but limited aspect, however, the term "public service" covers the activities of corporations that furnish the general public with a widely distributed and necessary utility, such as transportation, communication, heat, light, power, and water. Under this heading come steam and electric railway companies; marine navigation and canal companies; express, telegraph, and telephone companies; and so-called public utility companies.

Public service statistics may be defined as the statistical facts concerning (1) corporations engaged in public service

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and (2) their activities. They relate especially to number of companies, the extent of their operations, and the physical and financial results of operation.

Public service statistics are compiled and published by various agencies in the United States. The federal government has for years collected and disseminated statistics of many kinds. Recently there has been marked activity by the several states, through public service or utility commissions, bureaus of statistics, labor bureaus, and various other state institutions. Statistics are also gathered at the present time by a number of large cities through various departments.

In addition, many private organizations are engaged in the collection and tabulation of public service statistics. Among these are associations of corporations engaged in public service, such as the American Railway Association and the Bureau of Railway Economics among the steam railways, the American Electric Railway Association and the Massachusetts Street Railway Association among the electric railways, the National Electric Light Association, the Public Service Association of Virginia, and so on. Finally we have statistics promulgated by corporations themselves engaged in public service, in the form of annual reports to regulating bodies, periodical reports to stockholders, or communications to the general public.

Steam railway construction in the United States commenced with the Baltimore & Ohio Railroad. The first statistical table relating to railway operation in this country was contained in the first annual report of the Board of Engineers of that railway, dated September 30, 1828, which presented in tabular form an "approximate estimate of expenditures incident to the service" of the Baltimore & Ohio during the year ended August 31, 1829. The Baltimore & Ohio Railroad and other roads as they came into being have from the beginning made annual reports to their stockholders, containing more or less statistical matter.

The first attempt by public authority to gather steam railway statistics in the United States was in the state of Massachusetts, which in 1836 required "the directors of every such

(railroad) corporation, from year to year, to make report to the legislature, under oath, of their acts and doings, receipts and expenditures, under the provisions of their charter." A later Massachusetts statute of 1846 specified the items to be covered by the railways in their returns, among which were returns of casualties.

I have examined Massachusetts Senate Document 49 for 1836, containing the annual reports of five railways for 1835. The series is headed by the report of the Andover and Wilmington Railroad Corporation, giving merely the amounts received and expended during the year. The reports of other roads are hardly more detailed.

Massachusetts was closely followed by New York, where a resolution of the Assembly in 1843 directed the several railroad companies of that state to furnish the secretary of state certain statistical information each year. This was tabulated by the secretary of state and submitted annually to the Assembly in pamphlet form. Assembly Document No. 129, for example, dated March 1, 1845, presents statistics for fifteen of the twenty railways of the state, covering the operations of the year 1844, and gives the following statistics: mileage, cost of construction, maintenance expenses, freight and passenger receipts, dividends, horses and equipment, machine shops, freight and passenger train miles, passengers carried, and in most cases statistics of employees.

Other states, especially in New England, also made early provision for the collection of railway statistics, but not until the creation of the first state railway commission was the field of public service statistics really covered. While Rhode Island had a so-called railroad commissioner as early as 1844, the first railroad commission was created in New Hampshire in that year, a body of general railroad commissioners in Connecticut in 1853, boards of railroad commissioners in New York and Vermont in 1855, and a railroad commission in Maine in 1858, followed by Massachusetts in 1869 and Illinois in 1871. In fact, prior to the passage of the federal interstate commerce act of 1887, a majority of the states had established regulative or advisory railway boards or offices. At the present time only three states—Delaware, Utah, and Wyoming—have no rail-

way, public service, or corporation commission with jurisdiction in some form over railways.

Statistical work has been carried on by the federal government from its very establishment, the earliest effort being centered on decennial censuses. An act of 1820 provided for the collection of commercial statistics, and also of the amount or tonnage of *navigation employed in foreign trade.* This was the first provision for public service statistics in the United States.

The Federal Bureau of Statistics came into existence in 1844 in the shape of a group of clerks in the Treasury Department assigned to purely statistical compilation. The entry of the federal government into the field of railway statistics was, however, relatively late. The general appropriation act of 1875 created a division of internal commerce in the Bureau of Statistics, and provided that this division should, among other things, compile "statistics and facts relative to . . . the railroad systems of this and other countries, the construction and operation of railroads, the actual cost of such construction and operation of railroads, the actual cost of transporting freight and passengers on railroads and on canals, rivers, and other navigable waters of the United States, the charge imposed for such transportation of the freight and passengers, and the tonnage transported."

This division of internal commerce of the Bureau of Statistics, in its first report, June 30, 1876, described the principal trunk railroads of the country and presented a few transportation statistics. In 1878 there was created the office of auditor of railroad accounts in the Interior Department, later called the commissioner of railroads, whose duties were to prescribe a system of reports from all railways receiving aid from the government. The second report of the auditor, published in 1880, contained a statement of the condition of the Pacific railroads, statistics of railway accidents, and a comparison of certain railways for 1878 and 1879. Later reports contained also statistics of railway construction and development, and of railway indebtedness.

The act to regulate commerce was approved February 4, 1887. The important section of the act, so far as the collec-

tion of statistics is concerned, authorized the Interstate Commerce Commission to require annual reports from common carriers containing statistics of capital stock, dividends, surplus, stockholders, funded debt and interest, cost and value of railway property, franchises and equipment, amounts expended for improvements and the character of such improvements, employees and their salaries, earnings and receipts, operating and other expenses, profit and loss, and a complete exhibit of financial operations each year, including an annual balance sheet. The act further authorized the Commission within its discretion to prescribe a uniform system of railway accounts.

This section, amplified in many details, remains today the authorization upon which the Commission bases its system of uniform accounts and detailed statistical reports from the carriers. Additional legislation has strengthened the hands of the Commission in enforcing its accounting and statistical regulations, exacting penalties for non-compliance, and exercising strict supervision by means of a corps of special examiners.

The first statistical report of the Interstate Commerce Commission appeared as a part of its annual report, and covered the operations of the railways of the United States for the fiscal year ended June 30, 1888. Since then the annual statistical reports of the Commission have grown in size and detail, and are now, in bulky volumes of seven or eight hundred pages, important source-books for the student of transportation problems. The statistical field covered in these reports has been considerably broadened to cover the detailed accounting practices of the railways, intercorporate relationships, extensions and improvements of property, balance sheet details, traffic, and many other features.

In addition, the Commission issues monthly statements of railway revenues and expenses, quarterly statistics of accidents, annual returns of the express and sleeping car industries, and periodical statistics as to safety appliances, boiler defects, hours of service, and the like.

The reports required by state railway commissions from the railways operating in their territory are similar to the reports required by the Interstate Commerce Commission from the

same roads. In fact, the Interstate Commerce Commission for some time has furnished many of the state commissions blank report forms into which the railways of the several states shall transcribe their returns for such commissions. Three fourths of the state commissions are so supplied at the present time. These report forms correspond to the report form of the Interstate Commerce Commission itself, except that the pages designed for entries regarding mileage, improvement of physical property, revenues and expenses, taxes, and traffic are adapted to show the conditions in each respective state. Certain items not distributable according to states are exactly the same for all forms. From the point of view of the railways concerned, it is highly advantageous that the report forms of the Interstate Commerce Commission and the various state commissions are practically uniform. Imagine such a railway system as the Santa Fe, which operates through twelve different states, being required to maintain its operating statistics according to twelve different accounting systems, in addition to the uniform system imposed by the federal commission. From the point of view of the student of general railway statistics, however, this coöperation between state and federal commissions is of little interest, for the important and significant annual returns of capital, income, balance sheet items and the like, made by a railway to the federal commission, will be found repeated practically without change in the statistical reports of as many states as are entered by the lines of that railway. The result is that the reports of the several state railway commissions, however valuable they may be from the regulative point of view, throw little new light upon the intrastate operations of railway companies. There are, however, exceptions to this rule, such as the reports of the Illinois, New York, Texas, and Wisconsin state commissions.

From the beginning, railway corporations have submitted periodical reports to their stockholders. The earliest was the report of the president of the Baltimore & Ohio Railroad, dated October 1, 1827, which was nothing more than an indefinite four-page prospectus of the plans of the company. Since then the reports of this and other railway companies have

grown continually in scope and detail. With the development of a uniform accounting system by the Interstate Commerce Commission, the reports of the steam railways to their stockholders have tended more and more toward uniformity, comparability with past years, and clarity of statistical presentation. There is no question that this system of uniform accounting has greatly improved the privately compiled statistics of steam railways in this country. When it is noted that the railway mileage of the United States is greater than the aggregate railway mileage of the continent of Europe, the significance of the last remark will be clear, for to survey the operations of 250,000 miles of railway with anything like clear vision requires uniformity of statistics throughout.

In addition, the larger railways often prepare and issue general statements for public consumption, many of which are statistical in nature. These statements, like the annual reports of the companies, are prepared for the most part in well-equipped statistical offices, which are maintained by many of the principal railways. These offices are of great service also to the officials of their respective railways, preparing statistical memoranda that shall enable them to keep in touch with the details of current operation.

Furthermore, the American Railway Association and other coöperative associations do considerable statistical work, while it is becoming increasingly the custom for the railways to coöperate on a large scale in the preparation of statistical exhibits for presentation in wage arbitrations, rate cases, and the like. Recent examples of this coöperation have recently occurred in the Five Per Cent. case of the Eastern railways, and in the wage arbitration of the Western railways and their enginemen and firemen.

The first commercial electric railway in the United States was opened for operation in 1881. From no mileage in 1881 to nearly 50,000 miles in 1915 is a quicker growth than was shown by the first third of a century of steam railway construction. Because the new electric mileage of these thirty years has been burdened with denser traffic than the steam railways from 1830 to 1860, and because electric railways have doubled

their mileage in the past ten years, it is not strange that electric railway statistics have developed with relative slowness. Not until 1906, indeed, was the Interstate Commerce Commission given authority to collect statistics of electric railway operation. The Commission first requested reports from the electric railways for the fiscal year ending June 30, 1908, but no compilation of returns has yet been made. Even if it had been, such a report would not cover one third of the perhaps 1,600 electric railway companies operating today, and probably not half of the aggregate mileage; for the Commission has jurisdiction only over lines participating in some form of interstate traffic, and many municipal systems do not come under this head. In fact, in a recent case before the Interstate Commerce Commission, an electric railway company disclaimed the obligation to report accidents occurring in the course of intrastate operation, although willing to report accidents in interstate operation. If the steam railways were to make the same disclaimer, and refuse to report any but interstate accidents, it is clear that accident statistics would be much impaired.

Since electric railway statistics are not compiled by the Interstate Commerce Commission, it is well that the Census Bureau has since 1890 published reports on street and electric railway transportation. The latest such report covered the calendar year 1912.

More than half the state public service commissions have unqualified authority over electric railways within their state boundaries. Six or eight other state commissions have qualified regulative power, applicable only to interurban roads or roads lying outside the principal cities. The annual reports secured by state commissions from electric railways, as in the case of steam railways, are based largely upon the report form of the Interstate Commerce Commission. Half the states utilize this report form with the necessary modifications, and the tendency toward uniformity in electric as in steam railway statistics is growing.

The Eleventh Census, 1890, presented the first report upon the express business of the United States. Like the electric railways, express companies were placed by the Hepburn Act

of 1906 under the complete jurisdiction of the Interstate Commerce Commission. These companies make periodical reports to the Commission, which has compiled and published statistics of the twelve principal companies annually for several years.

In addition, the principal companies have been investigated by the Commission; these investigations have gone to the heart of the express business, have ascertained the value of express property, have unearthed the relations between express companies and railways, and have led to drastic changes in express rates and regulations.

These changes, together with the growth of the parcel post system and other business changes, have already led one company to withdraw from business, and have affected the profitable operation of the others. Clearly, statistics of the express business under these conditions, while interesting, are not of paramount social significance. Yet about three fifths of the state commissions require reports from the express companies operating within their boundaries, and are using the report form of the Interstate Commerce Commission, modified to suit their respective needs. A considerable number of these states publish annual statistics of express companies.

Marine transportation in the United States is so largely an interstate matter that the collection of marine statistics has been left in large measure to federal authority.

We have already seen that in 1820 an act of Congress provided for the compilation of statistics of navigation in foreign commerce. The census reports of 1850 to 1890 covered canals and improved waterways, and a special census of 1906 dealt with vessels engaged in water transportation, tonnage, income, freight and passengers, and employees and wages. More recently, the Bureau of Corporations has been issuing a series of reports dealing with water routes, volume of traffic, terminals, and form of control. The Board of United States Engineers publishes annual statistics of freight tonnage on the improved rivers and canals, but these are not summarized.

In addition, a few states compile statistics of steamboat

and canal traffic, such as the Erie Canal traffic in New York, but students of waterborne traffic will agree with the statement that these statistics are far from satisfactory or complete.

In fact, there has been nothing in the field of marine statistics to compare with the uniform and detailed railway statistics filed annually with the Interstate Commerce Commission and with the several state commissions. Beginning with the calendar year 1914, however, the Commission has ordered carriers by water with annual revenues above $500,000 to file detailed annual reports.

The telegraph is an older institution than the electric railway, but has not been regarded to the same extent as a public service, and only recently has the telegraph field been entered for regulative purposes by the federal and the state governments. The amendments of 1910 to the interstate commerce act, commonly known as the Mann-Elkins law, gave the Interstate Commerce Commission jurisdiction over telegraph and telephone, wireless and cable companies. Under this act the Commission may require reports from the telegraph companies, of which there are two large and a dozen small ones at the present time. No such reports have as yet been made to the Commission. Similarly, no reports are now filed by cable or wireless companies.

It is estimated that 11,000 telephone companies operate in the United States, exclusive of farmers' lines. These companies own approximately 10,000,000 residence and business telephones, or one for every two families throughout the country. Statistics of telephone operations would not only be extensive, therefore, but should be significant and interesting. The Interstate Commerce Commission was granted jurisdiction over telephone companies in 1910, and has recently issued orders to large companies, with annual revenues above $250,000, to file reports beginning with the calendar year 1914. Not more than three fourths of the 11,000 companies have interstate connections, and a very small proportion of these do sufficient business to come under the requirement of the Commission.

The Census Bureau has published special reports on tele-

phones and telegraphs covering three years—1902, 1907, and 1912. These statistics the Bureau placed in comparison with statistics collected in the census of 1880. The latest bulletin on the subject covers practically all the telegraph and telephone companies of the United States.

The field of telegraph and telephone statistics has also been entered by several states, about twenty of which publish periodical statistics thereof, and by the private organizations of the companies themselves.

Since 1910 the Interstate Commerce Commission has required annual reports from the Pullman Company. With the exception of pipe lines and sleeping car companies, whose operations are almost exclusively interstate, other forms of public service are mainly local, such as the operations of gas and electric light plants, power plants, heating systems, water companies, and the like. These industries are in part covered by the Census Bureau in its reports of manufactures and the electrical industries, and in its statistics of cities; in part by the reports of about twenty state public service or utility commissions; and in part by municipal reports.

It were idle to attempt detailed appraisal of public service statistics within the limits of this brief paper. I will merely suggest a few general criticisms of federal, state, and private statistics. Before entering on this, however, it may be well to point out that public service statistics, like all other statistics, should be judged on the basis of serviceability. If statistics do not assist in solving the many problems of today, if they befuddle the brain instead of stating simple truths, they were better not compiled.

The earliest and most consistent complaints of federal statistics were directed primarily against their inaccuracy. For example, the results of the First Census of 1790 were regarded by many with skepticism, and complaints of error were leveled at all the censuses to 1850. Similarly, the earlier work of the Bureau of Statistics, which in the field of railway statistics was the predecessor of the Interstate Commerce Commission, was subjected to much criticism on the ground

of error. A commission of investigation reporting on that Bureau in 1877 called its work "so grossly and grotesquely inaccurate as to make the bureau an object of ridicule."

The progress of statistics has been so marked in the past forty years that the same criticism would not apply today to public service statistics as a whole. Yet into the statistical reports of federal and state commissions there creep, even in these latter years of grace, errors of omission and commission. It would be odious to give concrete examples without covering the field in detail, but it is not unfair to remark that the reports of the Interstate Commerce Commission are relatively free from error, when compared with the reports of the average state commission.* An extensive survey of the official railway statistics of foreign countries leads to the further remark that American reports average as high in this regard as most foreign reports. Whatever the results here or abroad, the underlying cause of the errors is carelessness at some point. And as the ultimate goal of statistical work is to present facts, public service statistics cannot be regarded with complacence till inaccuracy shall have been reduced to a minimum.

Another oft-repeated complaint against government statistics protests the delays attendant upon their preparation and publication. The commission of 1877 on the Bureau of Statistics, for example, strongly recommended increasing the timeliness of the reports of that Bureau. That same recommendation could be repeated with emphasis regarding the

*It is not unfair to cite the following from the Annual Report of the Public Utilities Commission of Rhode Island for 1913, pp. 92–93, as a gross form of error.

PASSENGER TRAFFIC.

	Average distance carried.	Average receipts per passenger per mile.
Road A	18.50	$.01737
Road B	5.53	.04033
Road C	2.00	.01841
Total	26.03	$.07611

FREIGHT TRAFFIC.

	Average distance of haul of one ton in miles.	Average receipts per ton per mile.
Road A	96.43	$.01345
Road B	4.94	.12812
Road C	2.00	.01445
Total	103.37	$.15602

Truly, the *addition* of these averages to reach a general average should make the shades of the early New England statisticians start up with a groan!

statistical reports of practically all public service bodies of today. The compilation of statistics gathered from many sources is a slow and tedious process; yet this need not deter complaint when reports are unduly delayed in appearance. When a report on steam railway operations is issued annually, it does not seem unreasonable to expect the issue for a given year to appear before the close of the next succeeding year. Yet such reports have in recent years been delayed eighteen, twenty, and even twenty-five months after the close of the fiscal year to which they applied. So far as the Interstate Commerce Commission is concerned, the improvement in this regard has been notable, and especially in the matter of monthly statements of revenues and expenses, which have continually tended toward currency. Privately compiled statistics of public service also approximate a fair degree of timeliness, but the statistical reports of state commissions are sometimes much delayed. The vital connection between promptness and serviceability in the field of public service statistics hardly needs emphasis, and one has only to consider the close relation between the transportation industry and business in general to realize how important is the current statistical record of that transcendent industry. In this matter of timeliness, we may take Pharisaic satisfaction in that we are no more dilatory than many foreign statistical offices, but when we consider how delayed their reports occasionally are, our satisfaction cannot be great. The official statistics of French railways for the year ended December 31, 1911, for example, were not released till the end of 1913, or two years late; while other countries are at times even more behindhand.

Still another general criticism, closely related to that of inaccuracy, relates to insufficient clearness. Reports lose greatly in effectiveness when their tables are poorly constructed, insufficiently introduced and explained, or carelessly entitled. An ambiguous title over a table is hardly better than no title at all; a table thrown into a report with little or no explanation of its source, its underlying bases, its scope, or its qualifications, is of distinctly less utility than no table at all. Discrepancies among tables should be invariably explained. Furthermore,

a table whose steps are hard to follow, or the significance of whose contents you must stand on your head to appreciate, may be better than nothing, but this the exasperated student is sometimes tempted to deny. To clarify is to simplify, nine times in ten; and there is no more cheerful handmaiden to serviceability than simplicity.

There is room for difference of opinion as to whether interpretative text should accompany statistical tables or not, but if included at all the text should be clear, unambiguous, and sufficient. The parrot-like textual comment that stalks so often through the pages of our public service reports, being repeated page after page in the same report, or year after year in the same series of reports, should be eliminated. It adds nothing to the utility of tabular matter, but tends rather to conceal the salient features of the different tables. The suspicion steals across the brain that this kind of text is prepared either by a statistician who has much to learn, or else is entrusted to junior clerks to be ground out at the rate of so many paragraphs per hour. Few of the reports of our public service commissions are wholly free from this worse than useless custom.

The problem of coördinating the statistical reports of the various branches of the federal government happily does not exist, so far as public service statistics are concerned; for these statistics are entrusted largely to one federal body, the Interstate Commerce Commission, and even where this is not the case, the spirit of coördination and coöperation has been marked. Recent examples are the coöperative efforts of the Commission and the Census Bureau in ascertaining the physical value of railway operating property and in compiling statistics of express companies.

Finally, this comment upon the weaknesses of public service statistics in the United States would be imcomplete unless it registered a vigorous protest against the custom, so prevalent in many reports, of presenting countless pages of detailed tabular matter without adequate summaries or logical arrangement. In some cases, even, no attempt is made at tabular presentation. Nine tenths of the expenditure underlying statistical work that sees the light in such form has been

wasted, yet some state commissions publish reams of statistics of this nature every year.* These same commissions usually add to their other statistical vices that of trying to give too much information, with the result that their reports are not only badly arranged, but contain much data of little value. This is a waste of time and money, and greatly contributes to unintelligibility.

We have seen how the development of public service statistics of all kinds has proceeded during the past few decades, and have briefly reviewed the present situation. Is the statistical work now under way worth the energy and the millions of expenditure it involves, should it be added to and increased, or is it rather the wise thing to curtail it?

In this connection, I wonder if students of modern social problems do not sometimes feel themselves in the position of the boy in the legend who took on board ship a mill which upon the repetition of certain magic words would commence grinding salt. The boy uttered the words and the mill started grinding, but when he desired to stop the mill, he found he lacked the necessary formula. In spite of efforts, the mill continued to grind salt until it sank the ship to the bottom of the sea. Legislatures and statisticians have in the past been winding up the mills that grind out year after year countless statistics of the public service. Are we not inclined at times to feel that we have lost the formula for stopping the mills?

However this may be, I think few students believe, and possibly still fewer hope, that public service statistics should be collected and compiled in any less detail than at the present time. Indeed, the majority would doubtless assert that the commanding need is for greater detail, especially in the way of uniform accounting methods, cost accounting systems, statistics of corporate relationship, and the physical statistics of operation. Into this discussion of the lines along which statistics of public service should or will develop, it is not the function of this paper to enter.

* Thus the seventh annual report of the Railroad Commission of Oregon, December 15, 1913, contains over eighty pages (pp. 155-237) of closely printed statistical matter presented almost wholly in running text, without tabular arrangement.

Indicating in this general way that public service statistics are likely to increase in detail and in complexity, the next question relates to the functions of this Association with regard to such growth. Should we as a body take formal steps to influence the development of public service statistics along any lines? The American Statistical Association has in the past taken such action. For example, in 1843 this Association, then four years old, submitted a memorial to Congress severely criticising the census statistics of 1840. Is it the function of this Association to revive or continue what may be termed high-grade lobbying practices with regard to the development of public service statistics in the future?

It seems to me that the answer to this question should be a negative, at least until our membership feel more strongly that the Association should enter polemic fields to influence the progress of statistical work in lines of public service activity. This need not prevent the Association, however, from entering dignified protest, through the regular officials or through standing or special committees, whenever it is deemed essential. For example, if a public service commission should be issuing grossly inaccurate or distinctly unfair statistics, it appeals to me the machinery of this Association could not be better employed than in creating a sentiment of disapproval among statisticians and in preparing formal protest to be lodged with the proper authorities.

The functions of the individual members of the Association, moreover, should be exercised in the way of assisting the progress of statistical work wherever they come into contact with it. If they see opportunity for suggestion or kindly criticism at any point, it is their duty to seize the opportunity. If they have views as to the proper lines along which public service statistics should be developed, they may well devote their energies to that development. If their sentiment leans toward curtailment, that certainly is their field of effort. In any case, they can and should devote their heartiest efforts toward improving public service statistics of all kinds, making them more accurate, more nearly complete, more illuminating, and in every way more serviceable.

INFANT MORTALITY IN FALL RIVER, MASSACHUSETTS—A SURVEY OF THE MORTALITY AMONG 833 INFANTS BORN IN JUNE, JULY, AND AUGUST, 1913.

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The present study of infant mortality in Fall River originated with the Civic Department of the Woman's Club of that city, which was interested in practical measures for reducing the high infant death rate known to exist there. The data for the investigation were collected by the members of the District Nursing Association of Fall River; the information was later transcribed upon the infant mortality blank prepared by the Russell Sage Foundation. The author of this paper holds himself responsible neither for the blank used in the compilation nor for the completeness of the record of the various items tabulated. He has reason to believe, however, that the records which have come under his sight for study have been prepared with care, and that they are in all probability accurate statements of the conditions found by the members of the Nursing Association at the time of their visits.

This investigation covers the history of 833 infants born in Fall River during a period of 3 months—June, July, and August, 1913. These cases were not all registered at the time of birth. A thorough method of canvassing was employed by the nurses to locate babies born during these three months; some were not discovered until their death certificates were examined. Babies were visited from time to time, and a record was made of the findings at each visit. This record covered the condition of the baby, that of the mother, the mode of feeding, housing conditions, and other items of interest. A final visit was made on the anniversary of birth, at which time a fairly complete record was made.

Of the 833 births, 30 were recorded as stillbirths. One hundred and fifty-two additional deaths are known to have

occurred in the course of the year. No data are available for one of these deceased infants; it has seemed wiser, therefore, to eliminate it both from the records of births and from those of deaths. This study will be concerned, then, with 30 still-births, 802 live births, and 151 deaths.

Death Rate. If the 802 infants born alive had been kept under observation throughout the entire year, or until earlier death, the death rate in Fall River would have been 187 per 1,000 live births. As a matter of fact, 116 infants were lost from observation during the year. Of this number, 22 were under observation less than 1 week, 28 less than 1 month, and 106 less than 4 months. None of the 116 was under observation more than 6 months. The death rate of 187 per 1,000 is therefore an underestimate, since some of these 116 children, in all probability, died outside of the confines of Fall River and were not recorded as deceased. We have, therefore, constructed the annual death rate by summing up the 4 quarterly death rates, correcting the denominator at each period for departures of infants from observation. These 4 quarterly rates are 131.8, 15.1, 36.4, and 19.0, respectively. The annual death rate is therefore 202.3.

It should be remembered that this rate of 202.3 per 1,000 live born is for a limited number of infants born during the three summer months of June, July, and August. As will be shown later, there was a high mortality during the first few weeks of life, which was doubtless due, in part, to the effects of the season. This death rate must not, therefore, be considered as identical with the annual death rate, which is probably somewhat lower than this figure. According to Verrill,* the infant mortality rate in Fall River was 177.6 per 1,000 births in 1908; the Children's Bureau gives it as 186 per 1,000 in 1910. In any case, the rate in Fall River is almost twice as high as that now recorded for a number of large cities where efforts have been made to conserve infant life.†

* Infant Mortality and Its Relation to the Employment of Mothers in Fall River, Mass. Charles H. Verrill, U. S. Bureau of Labor. Transactions of the Fifteenth International Congress on Hygiene and Demography, Washington, 1913, pp. 318–337.

† In this discussion we have assumed the identity of the death rate and the infant mortality rate. This involves a slight error, which is not, however, sufficiently significant to justify an attempt at correction.

Stillbirths. There were 30 stillbirths in the series of 832 births—a rate of 36.0 per 1,000 births. This rate compares favorably with that of other cities. The number of stillbirths per 1,000 born as recorded for Johnstown, Pennsylvania, in the recent study by Emma Duke for the Children's Bureau,* was 56.7 for the year 1911; that for the city of New York for the year 1912 was 46.5; and that in the series of 10,000 cases born at Sloane Hospital † and studied by Holt and Babbitt was 44 per 1,000. The last figure excludes abortions.

The mothers of 8 of these 30 stillborn children were occupied in the mills during pregnancy; 19 mothers were engaged in housework only. The stillbirth rate was higher among the workers than among the housekeepers, the rates being 44 and 31 per 1,000, respectively. It should also be noted that 21 of these stillborn children were delivered by physicians and 6 by midwives; the stillbirth rate was then 40 per 1,000 for the former group and only 23 per 1,000 for the latter. The much higher rate for those delivered by physicians is doubtless influenced by the fact that physicians are likely to be called in cases which present difficulties too great for the midwives to handle.

Sixteen of the stillborn were males and 8 were females; the sex of the remaining 6 was not stated. Six, or 20 per cent., of the stillborn were premature.

Age at Death. The following table gives the number and percentage of deaths, and the rate per 1,000 iive births, for each period of life:

* Infant Mortality: Results of a Field Study in Johnstown, Pennsylvania, Based on Births in One Calendar Year, by Emma Duke. Children's Bureau, U. S. Department of Labor, Washington, 1915.

† Institutional Mortality of the New-born. Holt and Babbitt. Journal of the American Medica Association, January 23, 1915, pp. 287-290.

TABLE I.

INFANT DEATHS, PERCENTAGE OF TOTAL, AND DEATH RATE, BY PERIOD OF LIFE.

Period of Life.	Deaths.		
	Number.	Per Cent. of Total.	Rate per 1,000 Births. (a)
1st Year	151	100.0	202.3
1st day	25	16.6	31.2
1st week	37	24.5	47.4
1st month	62	41.1	79.7
1st quarter	102	67.5	131.8
2d quarter	11	7.3	15.1
3d quarter	25	16.6	36.4
4th quarter	13	8.6	19.0

(a) This column is corrected for the 116 infants who were lost from observation during the year.

The greater part of the mortality occurred during the first few weeks of life. The figures are in general similar to those presented for Johnstown by Miss Duke, and confirm the findings of Holt and Babbitt for the births studied at Sloane Hospital. The percentage of all deaths occurring during the first quarter year, 67.5, is higher than that found by Miss Duke for Johnstown, where the figure was 55.1. The corrected death rate for the first quarter, 131.8, is also much higher than that recorded by Verrill for Fall River for 1908; namely, 72.3. Our series, then, does not justify the comment of Verrill that the excessive infant mortality of Fall River is to be found, not in the earliest period of life, but at the ages over three months. Our conclusion must be that the excess of infant mortality is pronounced all along the line, being especially marked during the first month and, indeed, the entire first quarter year of life. It is also possible, of course, that the difference between the results of the two Fall River studies can be accounted for by the fact that our series is one of summer-born children, whereas that of Verrill covered the entire year.

A considerable number of the infants under observation were evidently born with serious physical defects, which resulted in death during the period soon after birth. A number of factors involved in this phenomenon present themselves for

consideration. We shall first attempt to get additional light on the subject from an examination of the causes of death.

Causes of Death. There were available for this analysis of cause of death not only the statement registered on the death certificate by the physician, but, in many cases, the statement of the visiting nurse as well. This additional information was often of value in the assignment of the case to the true cause. Thus the physician's statement of "Pneumonia" was in some instances supplemented by the nurse with the additional information of the existence of an acute infection such as whooping cough. The latter condition was given preference in our assignment. But where there was an actual conflict of causes in the two statements, preference was invariably given to that registered by the physician. Table II presents the number and per cent. of deaths by cause and by age at death.

TABLE II.

NUMBER AND PER CENT. OF DEATHS BY CAUSE AND BY AGE AT DEATH.

International List Number.	Cause of Death.	Deaths by Period of Life.								
		1st Year.		1st Day.	1st Week.	1st Month.	1st Quarter.	2d Quarter.	3d Quarter.	4th Quarter.
		Number.	Per Cent. of Total.							
	All Causes	151	100.0	25	37	62	102	11	25	13
104	Diarrhea and enteritis	50	33.1	—	1	13	42	2	2	4
151	Congenital debility, icterus, and sclerema	*31*	*20.5*	*13*	*17*	*24*	*28*	*2*	*1*	—
	(1) Premature births	17(a)	11.3	12	16	17	17	—	—	—
	(2) Congenital debility	14	9.3	1	1	7	11	2	1	—
91	Bronchopneumonia	16	10.6	—	—	—	—	4	6	6
152	Other causes peculiar to early infancy	*15*	*9.9*	*8*	*15*	*15*	*15*	—	—	—
	(1) Accidents of labor	8	5.3	3	8	8	8	—	—	—
	(2) Other causes peculiar to early infancy	7	4.6	5	7	7	7	—	—	—
92	Pneumonia (including lobar)	8	5.3	—	—	—	2	—	6	—
150	Congenital malformations	*8*	*5.3*	*4*	*4*	*7*	*7*	*1*	—	—
	(2) Congenital malformations of the heart	6	4.0	3	3	5	5	1	—	—
	(3) Other congenital malformations	2	1.3	1	1	2	2	—	—	—
8	Whooping cough	7	4.6	—	—	—	3	—	4	—
89	Acute bronchitis	6	4.0	—	—	1	2	1	2	1
28	Tuberculosis of the lungs	2	1.3	—	—	—	—	—	1	1
	All other causes	8	5.3	—	—	2	3	1	3	1

(a) Eight additional premature births were reported in conjunction with other causes.

The largest number of deaths was due to the group of causes embraced by the designation "Diarrhea and Enteritis" (title 104 of the International List); 50 deaths are so recorded, or about one third of the total. Of these, 13 occurred during the first month of life and 29 during the second and third months. It would appear that the latter months constitute a particularly dangerous period for the infants, since it is then that the change from breast feeding to other methods commonly occurs.

Other observers have similarly found that babies born during the summer show a high mortality from intestinal disturbances during the early months of life. Doubtless the danger is aggravated by exposure to the summer heat. The mortality from this group of causes during the second, third, and fourth quarters of the first year was very much reduced, although by no means negligible.

The proportion of "Diarrhea and Enteritis" to "All Causes," 33.1 per cent., is considerably higher than that usually found in other localities. The figure may be compared with the following percentages for 1913 for the Registration Area and a number of large cities.

PERCENTAGE DEATHS FROM DIARRHEA AND ENTERITIS OF DEATHS FROM ALL CAUSES UNDER ONE YEAR OF AGE, 1913.

Registration Area, United States	24.1
New York City	23.4
Boston	22.3
Detroit	19.4

Verrill, in his report on Fall River conditions in 1908, found an even higher proportion than ours; namely, 38.3 per cent. of the total. The ratio of diarrhea and enteritis deaths to deaths from all causes under one year of age, as reported for Fall River by the Bureau of the Census for the entire year 1913, was 34.9. Verrill ascribed the excessive mortality from these causes to the ignorance of mothers in feeding their infants. All other causes, according to him, take a secondary place. We shall later on consider this question in order to determine from our data what effects have been exerted on the mortality by the various methods of feeding employed by mothers. We

are warranted at this time, however, in concluding that the proportion from diarrhea and enteritis is too high, and that it is capable of very marked reduction if attacked along lines similar to those now well established in New York City, Boston, and Detroit.

As might be expected from the large proportion of early deaths, the causes included under the designation "Congenital Debility, Icterus, and Sclerema" form a very important group. Together they embrace 20.5 per cent. of the deaths. Of the 31 deaths under this title, 17 were stated as "Premature Births" with no further qualification. Eight additional premature births were reported in conjunction with other causes, and preference was given to the more definite statement. Thus 3 additional deaths were due to "Atelectasis" and 2 more were ascribed to "Accidents of Labor." These 5 cases appear in our table under title 152 of the International List, "Other Causes Peculiar to Early Infancy." Of the 3 remaining premature births, 2 cases are assigned to "Congenital Debility" (title 151), and 1 case to "Diarrhea and Enteritis" (title 104). There were, therefore, 25 deaths of prematurely born children in the total of 151 deaths, or 16.6 per cent.; this is an extraordinarily high proportion. Of these 25 children, 22 died during the first week of life. It is interesting to note also that 46 deaths of the 62 which occurred in the first month are traceable either to "Premature Birth," "Congenital Debility," "Accidents of Labor," or congenital malformations of one kind or another. All these causes point with especial emphasis to prenatal conditions and to the character of the obstetrical treatment which mothers in Fall River receive.

The respiratory diseases comprise 16 cases of bronchopneumonia, 8 cases of unqualified or lobar pneumonia, and 6 cases of acute bronchitis, a total of 30 cases. Of this number only 9 occurred in the first half year of life and 21 in the second half year. It is quite possible that these cases have been increased in number at the expense of the acute infections of which they may have been terminal conditions, although every effort has been made to assign to the infections (such as whooping cough, diphtheria, etc.) those cases in which there was sufficient evidence to warrant such action.

The acute infections are represented by whooping cough to the number of 7 cases and by diphtheria in 1 case. There were 2 cases of pulmonary tuberculosis and 7 other cases due to as many different causes.

Contributory Factors in Mortality. Infant mortality is the resultant of a considerable number of contributory factors. Some of these are primarily biological in character; others are principally economic and social. In the very nature of the case it will be impossible to measure with any degree of accuracy the effect of each on the mortality, yet together they determine whether the infant death rate of a community shall be high or low. In our discussion we shall take up in sequence the following factors, and shall point out how they bear on the conditions which we have found to exist:

(a) Attendance at delivery.
(b) Infant feeding.
(c) Age of mother.
(d) Nativity of mother.
(e) Occupation of mother.
(f) Occupation and wages of father.

(a) The following table shows the facts of infant mortality according to whether physicians or midwives assisted at delivery:

TABLE III.

NUMBER OF BIRTHS, CORRECTED NUMBER OF BIRTHS, NUMBER OF DEATHS, AND DEATH RATE, BY ATTENDANT AT BIRTH.

Attendant at Birth.	Number of Births.	Corrected Number of Births.(a)	Number of Deaths.	Rate per 1,000 Births.(a)
All Forms of Attendance....	802	746	151	202.4
Physician.....	507	483	96	198.8
Midwife.....	254	239	45	188.3
Other and unknown.....	41	24	10	—

(a) Correction has been made in this and in subsequent tables (except in Table IV) for the 116 cases lost from observation. The death rate for the entire group, 202.4, is slightly different from that given in Table I, because of the use of 746 instead of 746.4 as the denominator.

It would appear that the children born with physicians in attendance exhibited a much higher mortality rate than those born under the care of midwives. The numbers coming under the other heads are not sufficiently large to warrant their inclusion in the table. A considerable proportion, 49 per cent., of the deaths among the children born under the care of physicians occurred during the first month of life; the corresponding figure for those born with midwives in attendance was only 27 per cent. It is to be assumed that these differences are primarily the result of a process of selection, physicians having been called in those cases which presented special difficulties for either mother or child. Such cases would naturally show a higher death rate during the first year of life.

(b) So much importance has been ascribed to feeding that most investigations of infant mortality have resolved themselves into studies of the mode of feeding. Whether the child is breast fed or artificially fed, and how long breast feeding is carried on, are the best indices of the infant death rate to be expected. Such, in particular, were the findings of Verrill in his painstaking analysis of the situation in Fall River for the year 1908. He attributes the excessive mortality among the children of mothers at home to the absence of nursing and to improper feeding and improper care. "The much higher mortality among children of the mothers who went to work after childbirth," he says, "is plainly due chiefly to the greater extent of the absence of breast feeding and of the improper feeding and the additional evil influence of the withdrawal of the mother's care."

Our own analysis leads to an identical conclusion. Beginning with the second week of life, infant feeding is clearly the chief factor in the mortality. From this period onward, all other considerations take a secondary place. In the following table we have analyzed the mortality of the children as to whether they were breast fed or artificially fed, in whole or in part, at successive periods. We have for obvious reasons eliminated from this analysis the 116 infants who were lost sight of during the year. Nor have we considered the 37 infants that died during the first week, since they would hardly

reflect the influence of feeding. At the initial period, namely, the beginning of the second week, there remained for consideration 649 infants. These are traced to the conclusion of the first year or to earlier death. The death rates at each period show how markedly the mode of feeding affects the chances of survival.

TABLE IV.

NUMBER ALIVE AT TIME STATED, NUMBER OF DEATHS DURING REMAINDER OF YEAR, AND DEATH RATE, BY MODE OF FEEDING.

Mode of Feeding at Time Stated.	Number Alive at Time Stated.	Number of Deaths During Remainder of Year.	Rate per 1,000 Alive at Time Stated.
Beginning of 2d week: Total	649	114	175.7
(a) Breast feeding	565	74	131.0
(b) Artificial and mixed feeding	76	32	421.1
(c) Unknown	8	8	—
Beginning of 2d month: Total	624	89	142.6
(a) Breast feeding	514	52	101.2
(b) Artificial and mixed feeding	105	32	304.8
(c) Unknown	5	5	—
Beginning of 4th month: Total	584	49	83.9
(a) Breast feeding	405	26	64.2
(b) Artificial and mixed feeding	178	22	123.6
(c) Unknown	1	1	—
Beginning of 7th month: Total	573	38	66.3
(a) Breast feeding	368	18	48.9
(b) Artificial and mixed feeding	205	20	97.6
Beginning of 10th month: Total	548	13	23.7
(a) Breast feeding	335	7	20.9
(b) Artificial and mixed feeding	213	6	28.2

It is obvious, from the above table, that the breast fed infants are at every period better endowed for living than are the artificially fed. Furthermore, the seriousness of the handicap of the latter depends upon the shortness of the duration of breast feeding. Infants that were already artificially fed at the beginning of the second week showed the highest mortality, namely, 421.1 per 1,000. The corresponding rate of the breast fed was 131.0—less than one third as high.

At the beginning of the second month, the rates for the breast fed and the artificially fed infants were reduced to 101.2 and 304.8 respectively. The rate for the artificially fed was still three times as great as that for the other infants. At the beginning of the fourth month, the artificially fed children suffered from a mortality almost twice that of the

breast fed. This condition continued until the beginning of the seventh month. At the beginning of the tenth month, the difference in the death rates was comparatively slight for the two modes of feeding.

It is noteworthy that, of the 535 children that survived the year, 350, or 65.4 per cent., were breast fed for at least 6 months. Of this number, 328 were breast fed for at least 9 months. Breast feeding not only determines the chances of survival during the first year, but also affects the condition of the survivors at the end of the year. Of the 535 infants, 489 were in good condition at the beginning of the second year, 19 were said to be in fair condition, and 27 were poor. Of these 27, 17 were breast fed less than 6 months and 13 less than 3 months. It is in this way, perhaps, that the mode of feeding, in the first year, makes its influence felt on the mortality of the second and subsequent years.

(c) The age of the mother also influences the mortality of infants during the first year of life, as is shown in the following table:

TABLE V.

NUMBER OF BIRTHS, CORRECTED NUMBER OF BIRTHS, NUMBER OF DEATHS, AND DEATH RATE, BY AGE OF MOTHER.

Age of Mother.	Number of Births.	Corrected Number of Births.	Number of Deaths.	Rate per 1,000 Births.
All Ages.....	802	746	151	202.4
Under 20.....	33	29	3	103.4
20–29.....	408	386	73	189.1
30–39.....	267	257	53	206.2
40 and over.....	37	36	8	222.2
Unknown.....	57	38	14	—

The lowest death rate occurred among infants of mothers whose age was 20 and under; but this figure is hardly trustworthy in view of the small number of cases under observation. From age 20 onward, the mortality increased regularly with the age of the mother, the highest rate being among infants of mothers at ages 40 and over.

It is difficult to interpret the above rates in view of the many conflicting factors that enter into the discussion. In the first

place, it is proper to assume that the knowledge and skill of mothers in infant rearing increases with age. Other conditions, however, are apparently of sufficient force to more than negative the favorable effect of the increased experience of the mother. It is possible that with successive pregnancies the inherent weaknesses transmitted by mothers to their offspring become more pronounced. In addition, economic and social conditions, certainly among industrial workers, become more acute as the family increases in number, so that the vitality of the infant is impaired, not only through its prenatal but also through its postnatal environment. In any case, it is interesting to observe that a higher infant death rate has been noted by many authors to be correlated with the advancing age of mothers.

(d) The mortality of infants of foreign born mothers has been shown to be considerably higher than that of infants of native mothers in a number of American communities, including New York City, Boston, and Johnstown. The following table for Fall River confirms these findings:

TABLE VI.

NUMBER OF BIRTHS, CORRECTED NUMBER OF BIRTHS, NUMBER OF DEATHS, AND DEATH RATE, BY NATIVITY OF MOTHER.

Nativity of Mother.	Number of Births.	Corrected Number of Births.	Number of Deaths.	Rate per 1,000 Births.
All Countries.....	802	746	151	202.4
United States.....	253	242	37	152.9
Portugal and Azores.....	182	174	52	298.9
Canada.....	151	145	25	172.4
All other countries.....	216	185	37	200.0

The lowest mortality rate is found among infants of native mothers; the highest rate is among infants whose mothers came from Portugal and the Azores, reaching the unprecedented figure of 299 per 1,000. The inclusion "All Others," for which the rate is 200 per 1,000, embraces a considerable number of nationalities. Thirteen countries in all are represented, but the numbers for the individual countries under this heading are too small to warrant special treatment.

It is not our view that the fact of nationality is itself sufficient to determine the above differences. Foreign born mothers are probably as well equipped physically to bear healthy offspring as are native mothers. It is rather to be inferred that the mother's nativity is correlated with other conditions which play a very decisive part in determining the infant death rate. The foreign born mother in Fall River, for example, is more likely to work in the mills during pregnancy, to have many children, and to live in crowded and unhygienic quarters. She, more than the native mother, reflects the injurious influences of an unfavorable industrial and economic environment. We find, accordingly, that the excessive deaths of the infants of foreign born mothers are due especially to pneumonia, to diarrhea and enteritis, and to premature birth and congenital debility.

We may illustrate the above with reference to the infants of Portuguese mothers, who showed the highest death rate. Of the 182 mothers, 72, or 39 per cent., were engaged in work outside of the household during pregnancy, while only 17 per cent. of the mothers of other nationalities were so engaged. Of the 52 deaths of Portuguese children, 20 were due to diarrhea and enteritis, 17 to pneumonia and bronchitis, and 13 to prematurity, congenital debility, and other causes peculiar to early infancy.

(e) The participation of the mother in gainful work during pregnancy has been the subject of numerous investigations, from which the conclusion has usually been drawn that such work involves a high infant death rate as a consequence. We have, therefore, examined with special interest the data at our disposal, in order to determine, if possible, the relation existing between occupation of mother and infant mortality. The following table presents our results:

TABLE VII.

NUMBER OF BIRTHS, CORRECTED NUMBER OF BIRTHS, NUMBER OF DEATHS, AND DEATH RATE, BY OCCUPATION OF MOTHER.

Occupation of Mother.	Number of Births.	Corrected Number of Births.	Number of Deaths.	Rate per 1,000 Births.
All Occupations.....	802	746	151	202.4
Housekeepers.....	601	567	91	160.5
Gainfully employed.....	175	168	51	303.6
Unknown.....	26	11	9	—

There can be no question that the infants whose mothers were gainfully employed showed a much higher death rate than those whose mothers were engaged in housework only. Further examination discloses that those gainfully employed were almost entirely mill workers. It has therefore seemed unnecessary to bring into relief the small number of working mothers engaged outside of the mills. It has been impossible to determine from the schedules, with any degree of accuracy, how long before childbirth the employed mothers quit work, or how soon after childbirth work was resumed. We have therefore disregarded these important considerations in our table, illuminating though their analysis would have been.

(f) We are here concerned with the father not so much as a factor in the inheritance of the child, as in his character of a provider who determines the economic conditions of the household. That these conditions play a part in mortality, both during infancy and later, has generally been agreed. The highest death rates are found in the wards of cities where poverty is most common; the converse also holds good. These findings have recently received striking confirmation in the Children's Bureau study of Johnstown. The literature, and especially the German, is replete with trustworthy references to the strong positive correlation between low family income and high infant mortality. For it is the factor of income which determines the number of rooms occupied, their location in the city, the amount and character of the food, the need for supplementary work by the mother outside the home, and other considerations which bear directly upon infant mortality.

Unfortunately the data at our disposal did not lend themselves to an investigation of the mortality by amount of father's earnings, since a large proportion of the schedules did not give the wages of the father. It was possible, nevertheless, to get a measure of this item indirectly by analyzing the occupations of fathers. A multitude of occupations were, to be sure, represented, but the largest number of fathers were engaged in textile work. There were, for example, 169 mill operatives, 79 weavers, and 29 doffers and spinners. In all, there were 360 men employed in the mills. It was thought safe to combine these into one group for the purpose of our analysis. We did not include mill overseers, mill clerks, drivers of mill teams, etc. In other words, our group was made fairly homogeneous in its inclusion of inside mill operatives.

As opposed to them, 400 other fathers, engaged in a number of varied occupations, were brought together. They included a few professional men, clerks, carpenters, etc. This latter group is obviously heterogeneous, including the lowest paid as well as the best paid men in the community. Although the difficulties involved in drawing conclusions from such a contrast are obvious, the method will serve its purpose if it does no more than to indicate the singular condition prevailing among textile workers with reference to the mortality of their infants.

TABLE VIII.

NUMBER OF BIRTHS, CORRECTED NUMBER OF BIRTHS, NUMBER OF DEATHS, AND DEATH RATE, BY OCCUPATION OF FATHER.

Occupation of Father.	Number of Births.	Corrected Number of Births.	Number of Deaths.	Rate per 1,000 Births.
All Occupations.....	802	746	151	202.4
Textile occupations.....	360	342	69	201.8
Other occupations.....	400	379	70	184.7
Unknown.....	42	25	12	—

The findings of other observers are again confirmed. There is a difference of 17 deaths per 1,000 in favor of the infants of non-textile workers.

Of the 360 men engaged in textile work, the weekly wages were stated in 72 cases. The operatives, of whom there were 34, averaged $10.08, the 17 weavers averaged $10.23, and a number of others averaged $10.67. The average weekly wage for the group of 72 was $10.22. This figure is based on a return of only 20 per cent. of the total cases, and may not be entirely reliable, yet it is doubtless sufficiently accurate as an estimate. The earnings cited show very little variation from the average. They are considerably above the figures for textile workers furnished by the Federal Bureau of the Census and the figures furnished by the Bureau of Labor Statistics of Massachusetts.

It will not take us too far afield in the discussion of economic theory to note that this average weekly wage is too low to maintain a family in good health. It is not surprising, therefore, to find that 98 of the wives of the textile workers were engaged in work outside of their homes; this is 27 per cent. of the total. In only 17 per cent. of the cases in the other group were the wives so occupied. If, as has been shown above, the infant mortality is higher where mothers are engaged in outside work, we have discovered, in the low earnings of the father, one more link in the vicious chain of causes which place the infant mortality of Fall River among the highest in the country.

INCOME TAX STATISTICS.

By Roland P. Falkner, Ph.D., *Statistician, National Civic Federation.*

The adoption of a federal income tax has led students of economics and of public finance to hope for some illuminating material upon the distribution of national income and the operations of the tax. While the results as published in the annual report of the Commissioner of Internal Revenue are worthy of study, they are somewhat of a disappointment. This follows in part from the fact that the system is in its infancy, since the law as a whole affected the income of the year 1913 for ten months only and not the entire year, and since the provisions of the law regarding withholding at the source were operative for the last two months of the year only, and in part from the fact that the information given in the report is somewhat crude in form and meagre in detail.

TABLE I.

INCOME RETURNS FOR 1913.

Incomes for Ten Months, Ending December 31, 1913.		Equivalent Annual Incomes.		
Class in Thousand Dollars.	Number of Returns.	Class in Thousand Dollars.	Number of Thousand Dollars in Each Class.	Number of Income Returns per Thousand Dollars in Each Class.
2½ to 3½	79,426	3 to 4	1	79,426
3½ to 5	114,484	4 to 6	2	57,242
5 to 10	101,718	6 to 12	6	16,953
10 to 15	26,818	12 to 18	6	4,470
15 to 20	11,977	18 to 24	6	1,995
20 to 25	6,817	24 to 30	6	1,136
25 to 30	4,164	30 to 36	6	694
30 to 40	4,553	36 to 48	12	379
40 to 50	2,427	48 to 60	12	202
50 to 75	2,618	60 to 90	30	87
75 to 100	998	90 to 120	30	33
100 to 150	785	120 to 180	60	13
150 to 200	311	180 to 240	60	5
200 to 250	145	240 to 300	60	2
250 to 300	94	300 to 360	60	1.5
300 to 400	84	360 to 480	120	0.7
400 to 500	44	480 to 600	120	0.4
500 to 1,000	91	600 to 1,200	600	
1,000 and over	44	1,200 and over		

The most general information given in the official report concerns the number of individual incomes for which returns were made.* This is given in a table and chart, the essential features of the table being reproduced in the first two columns of the accompanying Table I. The remaining columns have been added by the writer to bring out the significance of the official figures.

The fact that the returns are for a period of ten months from March 1, 1913, to December 31, 1913,† and not for the calendar year 1913, has been lost sight of in most of the popular discussion of the results. It has, therefore, seemed desirable to add a column showing the annual equivalents for the different income classes given in the table.‡

The table contains a complete showing of all income returns, the obligation to make a return being imposed upon all persons having an annual income of $3,000 and upwards, or who had for the ten months, March to December, 1913, an income of $2,500 or upwards. Since married persons enjoy an exemption of $4,000, the returns include some incomes not subject to taxation. No record of this number is given in the report, information concerning the number of married and "single" persons being given not by classes of income but only for the whole number of returns.

The facts given in the second column as to the number of returns in each income group have been widely published by the press and much surprise has been expressed over the fact that the second group of the table is larger than the first. It has been cited as a very singular phenomenon, quite contrary to our general impressions, that smaller incomes are much more numerous than larger ones. The ingenious explanation

* For the United States as a whole the information is given in a chart and table facing p. 20, for collection districts on pp. 110-111, and for states on pp. 112-113.

† The chart and table facing p. 20 somewhat confuse the matter by referring to the returns as being for the taxable period, March 1 to December 31, 1914.

‡ In transforming the income classes given in the table into their annual equivalents, it has been assumed that the income reported for the ten months was five sixths of the annual income. In view of the fact that the months omitted were those of January and February, 1913, in which fall so many of the payments of interest on securities, it is more than likely that the remaining ten months represent somewhat less than five sixths of the annual income for the year. But as there is no way of estimating with precision the actual difference, we have throughout this paper generally assumed that annual incomes would be one fifth larger than those reported in 1913.

has even been offered that among the smaller income group there may have been an extraordinary amount of tax dodging.

An examination of the table will show that this apparently anomalous statistical fact results merely from the irregular grouping of incomes. If attention be given to the equivalent annual incomes it will be seen that incomes of the first group have a range of $1,000, those of the second of $2,000, and those of the third of $6,000. In the final column of the table here printed is a statement of the number of incomes for each $1,000 included in each group. It will be noted that in this column the distribution of incomes accords better with our general information. Not only is the first group more numerous than the second, but the third group which, in the original statement is nearly as large as the second, becomes only slightly more than one fourth as great.

The misleading impression of the official table is heightened by the accompanying chart. For the purpose of showing how a chart should not be prepared, it is reproduced here for comparison with a chart which gives a clearer view of the distribution of incomes.

A comparison of these general results with the experience of European countries, which have long had income taxes, is tempting but difficult. The British income tax is more complicated in its details than the American tax, and the official returns show the sources of income but do not show the whole number of incomes taxed. From time to time various writers have attempted estimates of the number of persons receiving incomes of a certain size. With the aid of figures drawn from taxes on legacies and on houses, Mr. L. G. Chiozza-Money* has estimated that in 1908–09 there were in the United Kingdom 280,000 persons in receipt of incomes in excess of £700 ($3,406). A comparison with the estimated population shows this number to be equivalent to 625 per 100,000. Though the minimum is higher in this estimate than in the United States the proportion of persons receiving these incomes is notably superior to that which results from our income tax figures. In Continental Europe incomes are taxed directly and the number of taxable incomes is available in the official records.

* Riches and Poverty, 1910.

The exemptions are commonly much less than in the United States and the whole number of incomes taxed cannot therefore be compared with the similar figures here. While statements for certain countries are available by income classes, the divisions used in the foreign figures do not permit an exact comparison. The last edition of Conrad's *Handwörterbuch der Staatswissenschaften* gives a very full statement of income statistics from which some facts may be selected which at least in a rough way may be compared with the figures for the United States. Such figures are given in Table II.

TABLE II.

INCOMES IN FOREIGN COUNTRIES AND THE UNITED STATES COMPARED.

Country.	Year.	Incomes above (Dollars.)	Number.	Population.	Incomes per 100,000 of Population.
France	1907	4,000	64,000	(a) 39,252,267	163
Austria	1907	2,400	25,600	27,729,500	113
German States					
Prussia	1908	2,375	105,000	38,026,556	276
Hamburg	1901	2,500		(b) 768,349	884
Saxony	1906	3,000	12,500	(c) 4,508,601	287
United States (d)	1913	3,000	356,579	96,765,563	368
	1913	4,000	277,499	96,765,563	287

a) 1906. (b) 1900. (c) 1905. (d) Excluding Alaska, Hawaii and Porto Rico.

The lowest income here noted is that which approaches most closely in the respective classifications to the United States minimum. Numbers differ widely according to the size of the countries considered, and reference to the population is necessary. France and Austria present a marked contrast, though the lower limit of incomes referred to is much higher in France, which has the largest proportion of such incomes. Austria, with a minimum income $600 lower than the United States has not even one third as many incomes above the minimum. Comparing incomes above $4,000, France has somewhat more than half as many as the United States. For the German Empire there is no imperial income tax, but such taxes are found in most of the states. The table shows figures for Saxony for the incomes above the $3,000 minimum, which are a little more than three fourths as numerous as in the United States. In Prussia incomes in excess of

$2,400 in round numbers appear to be somewhat less than three fourths as frequent in proportion to the population as are incomes in excess of $3,000 in the United States. Hamburg shows a percentage of incomes above $2,500 much higher than the figures for the United States. This higher percentage is not due to the lower minimum but rather to the fact that Hamburg is a rich city, the centre of the lucrative foreign commerce of the Empire. In the United States no separate figures are published for corresponding city areas, such as New York, Chicago, and Philadelphia. But we shall see later that as high a proportion to the population is found in New York State as a whole as in the city of Hamburg.*

The foregoing comparisons suffer under the fact that for the different countries compared the minimum income for which figures are given differs. This inconvenience can be removed, at the cost however of accuracy of statement, by estimating the number of incomes superior to $3,000 per annum for the purpose of comparing such estimate with the population and with the figures for the United States. In order to make such an estimate all the facts concerning the incomes in these countries were plotted in curves in such way that the height of the ordinate at any given point represented the whole number of reported incomes above that point. The curves for the different countries, with the exception of Saxony where the figure was already known, gave the following estimates of the number of incomes above $3,000 in the various countries, by means of which we have calculated the number per 100,000

Country.	Incomes of $3,000 and over.	
	Number.	Per 100,000 of the Population.
Austria	20,000	59
France	95,000	242
Prussia	75,000	197
Hamburg	——	700
Saxony	12,500	287
United States	356,579	368

* The second and third New York collection districts include the Borough of Manhattan. In these two districts the incomes returned numbered 50,049. If we compare this number with the population of Manhattan Borough, as returned in the Census of 1910, we find the unusual number of 2,142 returns per 100,000 inhabitants. Of course it is to be remembered that the taxes are paid at the principal place of business, and that not all who paid taxes in Manhattan are residents of that Borough.

of the population. In more convenient form this estimate shows the larger number of incomes of $3,000 and upwards which is reported in the United States as compared with all of the countries included in the comparison except the city of Hamburg.

In making these comparisons there is tacit assumption that the incomes reported in the United States are a full and complete indication of the wealth of individuals in this country but there is much reason to doubt whether the total number of returnable incomes actually in existence in the United States found its way into the treasury reports. The system of income taxation is in its infancy and it is more than probable that a considerable number of taxable incomes escaped the tax in the first year of its operation. Under the older and more vigilant administration of the tax in European countries a fuller report of all taxable incomes is probable. In presenting the figures given in Column 2 of Table I, the Secretary of the Treasury makes this comment upon the completeness of the returns:

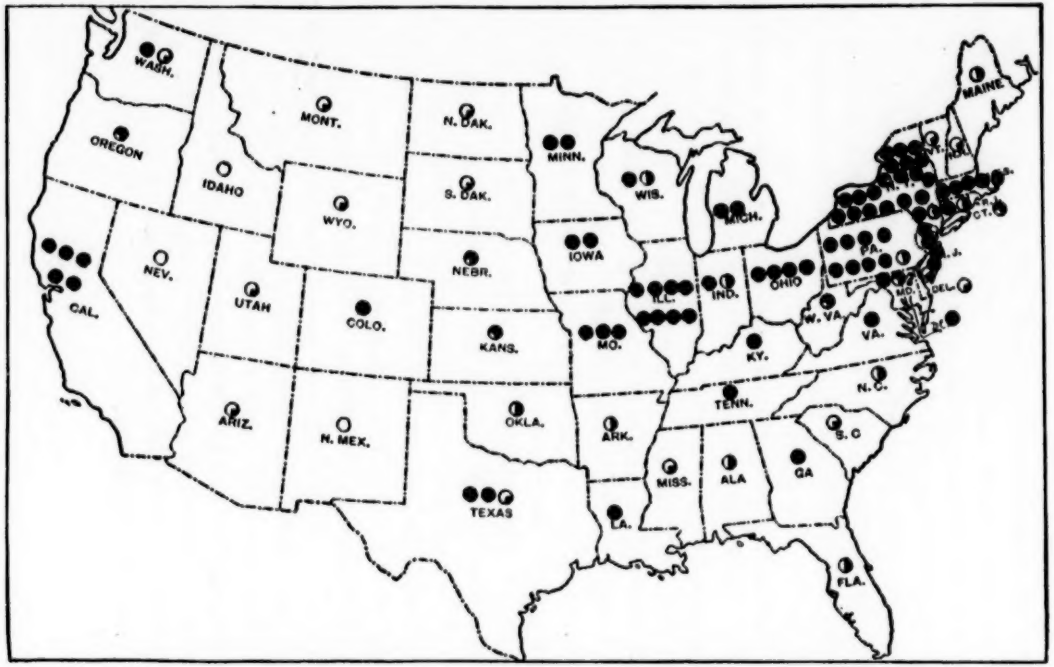
"It is obvious, upon the face of the returns, that there were more than 79,426 persons out of a total population of approximately a hundred million in this country who had net incomes of from $2,500 to $3,333 for 10 months—the taxable period for the calendar year 1913. It may be said with equal truth that there were more than 114,484 people out of our entire population who had a net income of from $3,333 to $5,000, and more than 101,718 people out of our entire population who had a net income of from $5,000 to $10,000 for the same period. It is clear that there were thousands of persons who failed altogether to make a return as required by law."

It will be noted that especial emphasis is laid in this statement upon the lowest income class and indeed a consideration of the figures themselves suggests that the returns in this class are not so full and complete as in the subsequent classes. Incompleteness of the returns, particularly in this class, might be due in part to a desire to evade the tax but it is much more probable that it results in large measure from ignorance of the requirements of the law. The greater number of persons whose income fell in 1913 in the first group—equivalent to

$3,000 to $4,000 per annum—are not in fact subject to taxation because they can claim the benefit of the $4,000 exemption accorded married persons. That such persons are required to make returns although not subject to taxation is not generally known among the public and where it is known such persons are prone to be indifferent about making returns. If we knew how many of the persons who made returns in 1913 were not subject to taxation because of this exemption, we should be able to estimate how far the factor now under consideration had been at work in reducing the whole number of returns.

Returning to the specific information available in the report of the Commissioner of Internal Revenue concerning the incomes in the United States, our attention may first be directed to the geographical distribution of the returns, which is shown by the map accompanying this paper and by the tables which follow. The map shows the income tax returns to be numerous in a group of states extending from Illinois eastward to Massachusetts and in California. Elsewhere returns are comparatively few. When information concerning the income tax returns was first given to the public it received considerable attention in the press. Each newspaper was of course especially interested in its own state, but nearly all of them called attention to the fact that New York State alone had 81,972 returns, or over one fifth of the whole number. In explaining this preponderance, the relation of New York City in the large number of returns to the state was pointed out, but the fact that New York is also the largest state in population was overlooked. The states whose income returns numbered over 10,000 are given in Table III, giving the number of returns for the leading states, and also comparisons with the population.

DISTRIBUTION OF INCOMES SUBJECT TO INCOME TAX



Explanation:—Each dark circle represents 4,000 returns, each quadrant represents 1,000 returns, the last 1,000 being rounded off. Empty circles indicate less than 500 returns.

TABLE III.

NUMBER OF TAX RETURNS FOR INCOMES EQUIVALENT TO $3,000 OR MORE PER ANNUM, BY STATES.

Area.	Returns.					
	All Incomes.			Incomes of $24,000 and over, Yearly.		
	Number.	Per 100,000 of the Population of April 15, 1910.		Number.	Per 100,000 of the Population of April 15, 1910.	
		Total.	Urban.		Total.	Urban.
United States (a)	356,579	388	860	23,114	25	54
New York	81,972	899	1,141	7,323	80	102
Pennsylvania	34,226	447	741	2,719	35	59
Illinois	32,242	572	950	1,935	34	56
California	19,557	822	1,323	933	40	63
Massachusetts	19,314	581	618	1,906	57	61
Ohio	16,078	337	628	1,043	22	39
New Jersey	13,345	526	700	783	31	41
Missouri	11,816	359	845	642	19	46
Total for states named	228,550	590	884	17,284	45	67
Other states	128,029	241	764	5,830	11	35

(a) Excluding Alaska, Hawaii, and Porto Rico, from which 1,019 returns were received.

The eight states named in the table contain a little more than two thirds of all incomes returned, but they comprised a little more than four tenths of the population of the country in 1910. In making comparisons with the population the figures of the 1910 census have been used. The utility of such comparisons between different states would not be greatly enhanced by estimating the population of 1913. It may be remarked that for the United States as a whole the ratio of 388 income tax returns per 100,000 of the population of 1910 becomes 368 when the estimated population of 1913 is used. In the group of states here named, the returns per 100,000 inhabitants are more than twice as numerous as in the rest of the country. New York stands at the head of the list in the ratio to the population as well as in absolute numbers, though California follows close behind in the ratio. The order in relation to population does not follow that of absolute numbers.

It cannot fail to be noticed that the states named are those

which contain the largest cities within their limits.* As it is probable that comparatively few of the persons receiving annual incomes of $3,000 and more live in rural communities, it has seemed desirable to establish a further ratio between the number of income tax returns and the urban population which as defined by the census comprises all persons living in communities of 2,500 inhabitants and upwards. Such a comparison shows that relatively the largest number of income tax returns is reported from California and not New York, the smallest number being from Massachusetts. Moreover there is comparatively little difference between this group of states and the rest of the country when ratios are established with the urban population only.

In the foregoing table incomes of $20,000 and over for ten months in 1913, equivalent to annual incomes of $24,000 and over, are shown separately. These are the incomes which in 1913 were subject to the additional tax. They are comparatively few in number, but are more frequent in the states here named than in the remainder of the United States.

The geographical distribution of $3,000 incomes for the different sections of the country, which are familiar in census usage, with ratios to the total and urban population, is shown in Table IV.

*The results of the first assessment make it clear that the income tax is primarily an urban tax. Over 40 per cent. of the entire tax is assessed in Milwaukee city alone, and more than 80 per cent. in the seventeen Counties containing cities. . . . Measured by income there are plainly more persons capable of paying taxes in the city than in the country. . . . 6th Biennial Report of the Wisconsin State Tax Commission (1912), p. 31.

TABLE IV.

NUMBER OF TAX RETURNS FOR INCOMES EQUIVALENT TO $3,000 OR MORE PER ANNUM BY DIVISIONS.

Area.	Returns.					
	All Incomes.			Incomes of $34,000 Yearly, and over.		
	Number.	Per 100,000 of the Population of April 15, 1910.		Number.	Per 100,000 of the Population of April 15, 1910.	
		Total.	Urban.		Total.	Urban.
United States (a)	356,579	388	860	23,114	25	50
The North	265,893	477	811	19,198	35	59
New England	32,277	493	592	2,956	45	54
Middle Atlantic	129,543	671	944	10,825	56	79
East North Central	68,720	430	714	3,996	22	42
West North Central	35,353	342	913	1,421	12	37
The South	55,736	190	842	2,376	8	36
South Atlantic	27,595	265	892	1,211	10	39
East South Central	10,690	142	679	427	5	27
West South Central	17,451	267	892	738	8	38
The West	34,950	512	1,050	1,540	23	46
Mountain	8,048	480	848	322	12	34
Pacific	26,902	1,113	1,129	1,218	29	51
East of Mississippi River	268,825	415	803	19,415	30	58
West of Mississippi River	87,754	322	959	3,699	14	40

(a) Excluding Alaska, Hawaii and Porto Rico, from which 1,019 returns were received.

This table confirms with greater detail that which preceded it. Returnable incomes are vastly more numerous in the North than in the South or West. But if reference be had to the total population it appears that relatively North and West have somewhere about the same number of returns, the advantage being for the West. The South falls far below. Quite different is the showing when comparisons are made with the urban population. In this comparison the South as well as the West exceeds the North in the number of returns. There is, however, less divergence among the various sections when the comparison is made with the urban population than when it is made with the general population. The distribution of returnable incomes among the different sections reflects, therefore, the distribution of urban population in those sections.

It may, however, be observed that the larger incomes are

more frequent in the older parts of the country. The largest proportions are found in New England and the Middle States. These divisions, with the Pacific division, are the only ones which exceed the average for the United States and appear in marked contrast to the other parts of the country.

With respect to the persons who pay the income tax, the report gives us the further information that 78,763 are single and 278,835 are married. It is to be remembered that in the income tax law these words have a significance different from that of the census and similar statistics. Under the income tax law the term married is only applicable to a married person who has a wife or husband, as the case may be, living with the person making the return. All other persons, whether bachelors or spinsters, separated, widowed or divorced, are single for the purposes of the income tax law. The "single" persons of the income tax payers are 28 per cent. of the total number, and in the population twenty-five years of age and upward such "single" persons are 26 per cent. of the total. It may also be noted that the 278,835 married persons represent 272,153 households, since 6,682 married women living with their husbands made a separate return of their incomes.

Concerning the income represented by these returns the report gives no definite information, though from the number of incomes and from the product of the tax some approximations may be made. The normal tax of 1 per cent. was levied upon incomes for ten months in 1913, in an aggregate amount of $1,272,803,802. While this is the taxable income it falls short of the true income, first by the amount of the personal exemptions, and second by the income received in the form of dividends. The personal exemptions of $2,500 for 78,760 single persons and of $3,333.33 for 272,152 married persons amounted to $1,104,084,166, which added to the taxable income makes a total of about $2,400,000,000. An additional sum to represent dividend income would have to be added to obtain the total income.

While the figures printed in the report do not give directly the total income, either for the income tax payers as a whole or for any of the different income classes represented in statistics, such information, at least so far as the larger incomes

are concerned, can be derived with the expenditure of no little patience from the figures giving the results of the supertax. The supertax is paid on the entire income and is not subject to deductions either for personal exemptions or for income from dividends. It is paid at varying rates on the excess of total incomes over $20,000. The report of the Commissioner of Internal Revenue gives the product of this tax according to the several rates of taxation, as follows:

Income Class, Thousands of Dollars.	Rate of Taxation. Per Cent.	Tax Collected.
20 to 50	1	$2,934,754
50 to 75	2	1,645,639
75 to 100	3	1,323,023
100 to 250	4	3,835,948
250 to 500	5	2,334,583
500 and over	6	3,437,850
Total		$15,511,797

The combination of the figures here given with those in a previous part of the report in regard to the number of incomes, enables us to analyze each of the several tax classes. Thus taxation at 1 per cent. falls in part on incomes exceeding $20,000 but less than $50,000, and in part on incomes exceeding $50,000. We know the aggregate amount of tax which is paid at the rate of 1 per cent. It is obvious that on all incomes higher than $50,000, the first $30,000 over the untaxed minimum of $20,000 is taxed at 1 per cent. As we know the number of such incomes the amount of the incomes so taxed can be determined and also the amount of the tax upon it. Having ascertained the taxation at 1 per cent. upon all incomes over $50,000, we can deduct this from the total receipts at 1 per cent., to find how much is attributable to the first class, namely $20,000 to $50,000. The amount collected by this taxation multiplied by 100 represents the income which is so taxed.

A similar process can be applied to taxation at the rate of 2, 3, 4, and 5 per cent., respectively, while for the taxation at 6 per cent. no calculation is necessary, as all income above $500,000 is taxed at this uniform rate. The results are shown in Table V.

TABLE V.

ANALYSIS OF ADDITIONAL TAX, SHOWING UPON WHAT INCOMES EACH TAX RATE FALLS.

Line Number.	Tax Class, Thousands of Dollars.	Income Class, Thousands of Dollars.	Number of Incomes Taxed.	Amount of Each Income Higher than the Class Taxed at thisRate.	Tax paid by Each Income Class.	Total Income Taxed in Each Class at This Rate.
1.....	20 to 50	20–50	17,961		$1,370,554	$137,055,400
2.....	taxed at 1%	50–75	2,618	30,000	785,400	78,540,000
3.....		75–100	998	30,000	299,400	29,940,000
4.....		100–250	1,241	30,000	372,300	37,230,000
5.....		250–500	222	30,000	66,600	6,660,000
6.....		500 and over	135	30,000	40,500	4,050,000
7.....			23,175		2,934,754	293,475,400
8.....	50 to 75	50–75	2,618		347,639	17,381,950
9.....	taxed to 2%	75–100	998	25,000	499,000	24,950,000
10.....		100–250	1,241	25,000	620,500	31,025,000
11.....		250–500	222	25,000	111,000	5,550,000
12.....		500 and over	135	25,000	67,500	3,375,000
13.....			5,214		1,645,639	82,281,950
14.....	75 to 100	75–100	998		124,523	4,150,767
15.....	taxed at 3%	100–250	1,241	25,000	930,750	31,025,000
16.....		250–500	222	25,000	166,500	5,550,000
17.....		500 and over	135	25,000	101,250	3,375,000
18.....			2,596		1,323,023	44,100,767
19.....	100 to 250	100–250	1,241		1,693,948	42,348,700
20.....	taxed at 4%	250–500	222	150,000	1,332,000	33,300,000
21.....		500 and over	135	150,000	810,000	20,250,000
22.....			1,598		3,835,948	95,898,700
23.....	250 to 500	250–500	222		647,083	12,941,660
24.....	taxed at 5%	500 and over	135	250,000	1,687,500	33,750,000
25.....			357		2,334,583	46,691,660
26.....	500 and over taxed at 6 %	500 and over	135		3,437,850	57,297,500

The figures in Table V are given by tax classes. They may be rearranged to show the incomes and the tax paid in each income class. Such a rearrangement of the material for incomes of half a million dollars and over is given in Table VI.

TABLE VI.

INCOMES OF $500,000 AND OVER (135 IN NUMBER).

Taxation Classes, Thousands of Dollars.	Rate of Tax Per Cent.	Portion of Each Income Taxed at Each Rate	Total Income Taxed at Each Rate	Tax paid at Each Rate.
Under 20	0	0	$2,700,000	0
20 to 50 (line 6, Table V)	1	$30,000	4,050,000	$40,500
50 to 75 (line 12, Table V)	2	25,000	3,375,000	67,500
75 to 100 (line 17, Table V)	3	25,000	3,375,000	101,250
100 to 250 (line 21, Table V)	4	150,000	20,250,000	810,000
250 to 500 (line 24, Table V)	5	250,000	33,750,000	1,687,500
500 and over (line 26, Table V)	6	All	57,297,000	3,437,850
			$123,057,500	$6,145,100

Without repeating the component parts of each income class —all the materials are found in Table V—we can gather the following information for total incomes, including the untaxed minimum of $20,000, which are subject to the additional tax.

Income Classes, Thousands of Dollars.	Number.	Income.
20 to 50	17,961	$496,375,000
50 to 75	2,618	148,281,950
75 to 100	998	79,000,767
100 to 250	1,241	166,448,700
250 to 500	222	68,441,660
500 and over	135	123,057,500
Total	23,175	$1,081,605,977

This leaves us with only the incomes from $2,500 to $20,000 to determine. An approximation to the total incomes should be obtainable from the numbers in the different income classes. The average income in each class has been estimated by adding to the minimum an amount equal to one third of the difference between the maximum and the minimum of each class. This estimate allows for the fact already noted that incomes fall off in number as they increase in amount. Whether the allowance is correctly made appears from a comparison of this estimate for figures already given for incomes over $20,000. To permit this comparison and to secure a complete estimate of total income on this basis the estimate is made for all classes, though our special interest at present is in the incomes under $20,000. The results are given in Table VII.

TABLE VII.

NUMBER OF INCOMES AND ESTIMATE OF THEIR AMOUNT.

Income Classes, Thousands of Dollars.	Number of Returns.	Estimated Income.	
		Average.	Total.
2½ to 3½	79,426	$2,778	$220,645,428
3½ to 5	114,484	3,889	445,228,276
5 to 10	101,718	6,667	678,153,906
10 to 15	26,818	11,667	312,885,606
15 to 20	11,977	16,667	199,620,459
20 to 25	6,817	21,667	147,703,939
25 to 30	4,164	26,667	111,041,388
30 to 40	4,553	33,333	151,765,144
40 to 50	2,427	43,333	105,169,191
50 to 75	2,618	58,333	152,715,794
75 to 100	998	83,333	83,166,334
100 to 150	785	116,667	91,583,595
150 to 200	311	166,667	52,833,431
200 to 250	145	216,667	31,416,715
250 to 300	94	266,667	25,066,698
300 to 400	84	333,333	27,999,972
400 to 500	44	433,333	19,066,652
500 to 1,000	91	666,667	60,666,697
1,000 and over	44	$1,500,000	66,000,000
Total	357,598		$2,982,729,225

In applying the method described to the group receiving $1,000,000 and over, which, of course, has no upper limit, it was necessary to assign to this group a purely arbitrary estimate of the average income. The aggregate of incomes under $20,000 appears in this table as $1,856,533,675, while the estimate for the group $20,000 to $500,000 is $999,528,853. The correct figure for the group $20,000 to $500,000 is $958,548,477. We have, therefore, for this large group from $20,000 to $500,000 a direct comparison of actual figures and the estimate, and it appears that the correct figure is 95.9 per cent. of the estimated figure. It seems proper to assume that in the estimate of incomes under $20,000 we have the same excess. Deducting 4.1 per cent. from the estimate of such incomes and adding to the result the correct figures for incomes from $20,000 to $500,000, and for incomes for $500,000 and over, as given in a former table, we have a corrected estimate of an aggregate income of $2,862,021,776 for ten months in 1913, of all persons who had in that period a minimum income of $2,500. From the figures of the normal tax we had already accounted for an income of $2,370,000,000, and if this sum be deducted from

our estimate of the total income it would appear that there is a difference of $490,000,000 to be explained by the income received in the form of dividends, which is not subject to the normal tax. It will be interesting to inquire whether the corporation income tax throws any light upon this subject of dividend income.

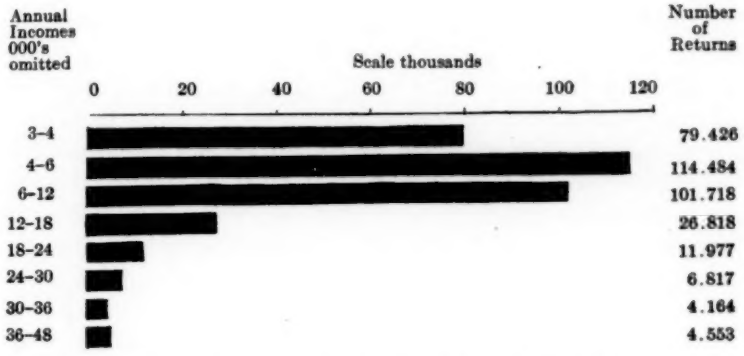


Diagram I. Incomes reported 1913 as shown in report of Commissioner of Internal Revenue

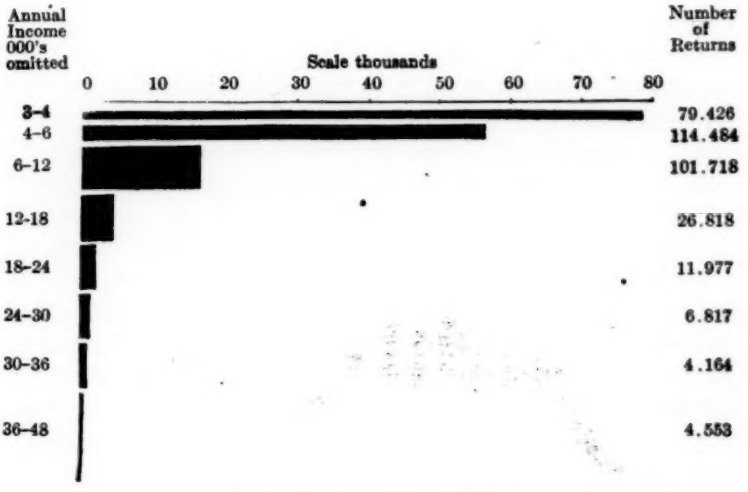


Diagram II. Incomes reported 1913

The tax upon the net income of corporations for ten months of 1913 produced $32,456,662.67. As the tax is 1 per cent., it was therefore levied upon a corporate income of $3,246,000,000. How much of this corporate income was distributed in the form of dividends we have no means of knowing. If dividends averaged only 4 per cent. of the reported capital stock of $64,000,000,000 for all corporations paying taxes, dividend payments would have amounted to $2,640,000,000.* Of course all dividend payments do not become personal income; a large part of it is corporate income of holding companies and to some extent of investing companies, such as savings banks and insurance companies. But it does not seem unlikely that as much as $2,000,000,000 becomes personal income. If this be correct it must be confessed that such income is not fully accounted for in the calculation of personal income which allowed only $490,000,000 for income of this nature to income tax payers. Of course a certain portion of this dividend income goes to persons who are not affected by the income tax, whose annual incomes are less than $3,000, but it seems doubtful whether the greater part goes to such persons.

The foregoing computation necessarily assumes that the figures are correctly reported both for the number of incomes and for the receipts at each tax rate. It would seem unnecessary to mention this assumption were it not for the fact that a closer study of the tables showing the returns of incomes on pages 112 and 113 of the report with the table giving the tax receipts, shows many inconsistencies between the tables. It may be that for the total of the United States the inaccuracies of the tables counterbalance one another and the result which we have obtained can be regarded as substantially correct.

Unfortunately the method of ascertaining incomes which is here indicated cannot be applied to the individual states because of inconsistencies between the two tables which are combined in this operation. Some of the inconsistencies are obvious and some lie below the surface. Some of the most

*In his work on "Income" (New York, 1915), p. 146, Dr. Scott Nearing estimates the dividends paid in 1913 by the corporations reporting to the Commissioner of Internal Revenue as between 2,300 and 2,900 million dollars.

unmistakable discrepancies between the figures are shown in the following comparison of the highest classes which are indicated by the respective tables of the Report of the Commissioner of Internal Revenue:

MAXIMUM INCOMES IN CERTAIN STATES, ACCORDING TO INCOME CLASSES SUBJECT TO ADDITIONAL TAX.

State.	Highest Income.	Group Indicated by.
	Returns of Income (pp. 112–113.)	Receipts from Additional Tax (pp. 192–193.)
District of Columbia	$250,000 to $500,000	$500,000 and over
Florida	75,000 to 100,000	500,000 and over
Georgia	100,000 to 250,000	500,000 and over
Indiana	250,000 to 500,000	500,000 and over
Nevada	20,000 to 50,000	250,000 to $500,000
Alaska	50,000 to 75,000	30,000 to 50,000
Arizona	100,000 to 250,000	30,000 to 50,000
Idaho	100,000 to 250,000	Under 20,000
Mississippi	100,000 to 250,000	75,000 to 100,000
Montana	75,000 to 100,000	Under 20,000
North Dakota	75,000 to 100,000	50,000 to 75,000
Utah	100,000 to 250,000	Under 20,000
Washington	250,000 to 400,000	20,000 to 50,000
Wyoming	100,000 to 250,000	Under 20,000

But there are other discrepancies which are not so obvious and which would be revealed only by an examination of each state. Thus for North Carolina the table on page 112 reports 2 incomes between $250,000 and $500,000. The additional taxation upon these 2 incomes would be as follows: At 1 per cent., $600; at 2 per cent., $1,000; at 3 per cent., $1,500; and at 4 per cent., $12,000. But the actual receipts reported from all incomes in North Carolina at the rates of 2, 3, and 4 per cent., respectively, were less than the sums here named. Again, in Michigan we find 15 incomes reported as exceeding $250,000. Taxation at 4 per cent. falls on that part of such incomes which is above $100,000 and below $250,000, which, at $6,000 for each income, should give tax receipts of $90,000 for the 15 incomes to which reference has been made, without any consideration of other incomes which may fall between $100,000 and $250,000. But the receipts returned at 4 per cent. in the state of Michigan amount to only $85,228.

There is no clue in the report of the Commissioner of Internal Revenue as to the cause of these discrepancies. The suggestion naturally occurs that in some cases the taxes are in arrears and such an explanation would cover a number of discrepancies which have been noted, but not all of them. It would not, for instance, explain that in the state of Nevada a tax has actually been paid upon an income which can be estimated at $256,000, while no income higher than $40,000 appears in the tabulation of returns. Moreover there is no suggestion in the report of the treasury officials that any considerable proportion of the income tax is in arrears. According to the best information which I can obtain on the subject the discrepancies between the tables are due to the fact that they have been made by different sets of clerks, and that no effort has been made to check them one against the other. It also appears that classifications have been made at different periods of the year and that some of the discrepancies may be due to changes in the classifications which had taken place as a result of the activities of the treasury department.*

In view of the discrepancies to which attention has been called, we may well hesitate to attempt to ascertain the amount of incomes for any lesser areas than for the whole United States. With the exception of the state of New York, of which it forms a part, the Borough of Manhattan with its 50,000 taxable incomes is the largest group in the United States. The number is probably large enough to render of comparatively little significance the idiosyncrasies of the tables to which we have referred. Subject to these reservations we can, therefore, ascertain for the Borough of Manhattan the dis-

* The matter herein referred to was submitted to the Commissioner of Internal Revenue, who, under date of April 5, 1915, replied concerning the discrepancies which have been noted in part as follows:

"In reply you are advised that the table on pages 112–113 shows the correct classifications, numerically by states, and was compiled by this office from the individual returns themselves.

"The receipts shown in the table on pages 192–193, both items by states and totals, represent the actual collections for the fiscal year ended June 30, 1914, verified by this office as of that date. The classifications of income shown in this table, however, are based on the reports of Collectors of Internal Revenue from the facts before them at the time of their reports; and the exigencies of administration will not permit the office, at the present time, to trace the various changes that have since been made, or that have been required to be made, in individual returns as originally rendered."

One cannot feel that the explanation is subject to any other interpretation than that given in the text. While the writer asserts in the first paragraph that the table on pages 112 and 113 shows the correct classifications because they were compiled in the central office, one cannot feel complete assurance of this fact when we have a record of receipts on incomes higher than any of those named in the classification. The correspondence admits the discrepancies and does not, I feel, offer any explanation of their cause.

tribution of incomes represented by the returns. This is shown in Table VIII.

TABLE VIII.

INCOME TAX PAYERS AND INCOMES—BOROUGH OF MANHATTAN.

Income Classes, Thousands of Dollars.	Tax Payers.		Incomes.	
	Number.	Per Cent. of U. S. Total.	Total.	Per Cent. of U. S. Total.
2.5 to 20	44,481	13.3	$259,152,196 (a)	14.6(a)
20 to 50	4,058	22.5	109,592,400	22.1
50 to 75	697	26.5	37,802,233	25.5
75 to 100	293	29.4	26,308,233	33.3
100 to 250	353	28.4	46,287,825	27.8
250 to 500	91	41.0	26,170,100	33.9
500 and over	76	56.3	96,779,417	78.6
20 and over	5,568	23.6	342,940,025	31.7
Total	50,049	14.0	602,092,221(b)	21.0(b)

(a) Estimated. (b) Partly estimated.

It will be noted that while Manhattan has 14 per cent. of all the taxpayers, the income which they represent is 21 per cent. of the total estimated income in the United States. Generally speaking, the share attributable to Manhattan grows as the incomes become larger. The reader will not fail to observe that more than half of all the incomes of $500,000 and over are in Manhattan and that the income which they represent is more than three fourths of all the income of this class in the United States.

It would fall short of a complete analysis of the available figures were we to neglect the fiscal aspects of the tax. Besides considerations affecting the distribution of incomes there are others which are derivable from the report, and concern the weight of taxation, its geographical distribution, and its future fruitfulness, which may well engage our attention.

In a taxation system as composite as the income tax with its exemptions and graduated rates, there is an interest in ascertaining the total weight of the tax with reference to the total income. The total product of the tax in 1913 was $28,253,534, and this was levied according to our calculations upon a total

income of $2,862,021,776. Disregarding all exemptions, therefore, the taxes paid both as normal and as additional tax amounted to approximately 1 per cent. (0.98) of the total income of persons subject to income taxation. In the aggregate the normal tax was equivalent to 0.44 per cent. of the total income as computed. In view of the progressive taxation of the supertax, it would be desirable to carry out calculations similar to those indicated for each income class. Such a problem offers considerable difficulty on account of the scanty material at our disposal, regarding the normal tax. For the additional tax, however, exact information is available. Table IX exhibits the amount of additional tax paid by each income class and the resulting rate of taxation.

TABLE IX.

INCOMES OF $20,000 OR MORE AND ADDITIONAL TAX PAID.

Income Class Thousands.	Incomes.		Additional Tax Paid.	
	Number.	Amount.	Amount.	Per Cent. of Total Income.
20 to 50	17,961	$496,375,400	$1,370,554	0.28
50 to 75	2,618	148,281,950	1,133,039	0.76
75 to 100	998	79,000,767	922,923	1.17
100 to 250	1,241	166,448,700	3,617,498	2.17
250 to 500	222	68,441,660	2,323,683	3.39
500 and over	135	123,057,500	6,145,100	4.13
Total	23,175	$1,081,605,977	$15,511,797	1.43

Our table compares the total additional tax paid with the total income of the persons subject to such tax and not with their taxable income alone. While incomes of over $500,000 are subject to an additional tax of 6 per cent., this rate applies to the excess over $500,000—not to the total income. A person enjoying an income in excess of $500,000 pays his additional tax in the manner shown in Table VI, namely, no additional tax on $20,000, 1 per cent. on the next $30,000, 2 per cent. on the next $25,000, 3 per cent. on the next $25,000, 4 per cent. on the next $150,000, 5 per cent. on the next $250,000, and 6 per cent. on all beyond that, or beyond $500,000. A person therefore with an income of $600,000 would pay additional taxes to the amount of $26,050, equiv-

alent to 4.34 per cent. of his entire income. His total tax would be increased by the normal tax which by reason of the personal exemption and the omission of incomes, if any, from dividends, would be somewhat less than 1 per cent. His total taxation, if he were married and had no income whatever from dividends, would be 5.33 per cent. of his total income, while if we could assume the extreme case that all his income arose from dividends, his total taxation and his additional taxation would be identical, namely, 4.34 per cent. of his total income. Table IX refers to the additional tax only, and shows that it increases from an average of 0.28 per cent. on the incomes over $20,000 and less than $50,000, to 4.13 per cent. for the highest income class.

While we know that the normal tax averages 0.44 per cent. of total income of all classes, we cannot add this figure to the rates above calculated for the additional tax in the several income classes, to determine total taxation in each class. There are no figures given in the official documents showing receipts from normal tax by income classes, nor can these figures be calculated with any degree of precision. We could indeed estimate the distribution of income below the tax limit for normal taxation with a slight degree of error. For if we assume that the married and unmarried taxpayers are evenly distributed among the different income classes, we have only to distribute the exempted income (p. 532) in proportion to the number of taxpayers in each class. If we should deduct the personal exemptions, so estimated, from the aggregate income of each tax class as computed or estimated in the earlier part of this paper, we should have a series of figures from which we could derive the proportion of the normal tax receipts attributable to each tax class, always, be it noted, under the assumption that dividend income is distributed among the different classes in the same proportion as other income. By such a calculation we reach the tentative result that incomes under $20,000 paid $5,409,000 normal tax and incomes above that sum $7,319,000. If such were the receipts they were equivalent to a tax of 0.30 per cent. on total income of persons with less than $20,000, and 0.68 per cent. on total income of persons with larger incomes. But these results

would doubtless be changed if we knew anything about the distribution of dividend income. If dividend income is more frequently a constituent part of larger than of smaller incomes, then the amount of normal tax paid by incomes under $20,000 would be greater than the sum given above and the average rate of taxation would be also greater, while the converse would be true as respects incomes over $20,000. How large the change might be it would be hazardous to estimate. The possible limits can be, however, pointed out. If there were absolutely no dividend income received by persons having less than $20,000 income, the normal tax paid by such persons would have been $7,478,763 or 0.42 per cent. of the total income of this class. And if all the dividend income belonged to those whose incomes exceeded $20,000, their normal tax would have been $5,249,275 or 0.48 per cent. of the total income of this class. It is clear that whatever the distribution of dividend incomes, as between these two groups, the normal tax would always form a larger percentage of the total income of the group with higher incomes, than of the group with lower incomes.

The conclusion seems to be warranted that for incomes of less than $20,000 the total taxation which is all normal tax probably does not exceed four tenths of 1 per cent. of the total income of this group. It is further clear that to the rates for the additional tax shown in Table IX for incomes of $20,000 and over, there must be added for the normal tax a figure which is somewhere between 0.45 and 0.65 per cent. of the total income, if we are to ascertain the total rate of income taxation for these classes.

If for reasons already stated we must forego an attempt to compare geographically the number of incomes with the amount of such income, the tax receipts throw some light upon how far the distribution of income by numbers differs from that by amounts. In Tables X and XI figures are given for the amount of tax receipts, both for the normal tax and the additional tax, with relative figures showing also the distribution of taxable incomes, for the same geographical areas as figured in our previous tables.

TABLE X.

INCOMES AND TAX RECEIPTS BY LEADING STATES, 1913.

Area.	Incomes Subject to Normal Tax.			Incomes Subject to Supertax.		
	Tax Paid.	Per Cent. Distribution.		Tax Paid.	Per Cent. Distribution.	
		Tax Paid.	Number of Incomes. See Table III.		Tax Paid.	Number of Incomes. See Table III.
United States	$12,711,050	100.0	100.0	$15,505,232	100.0	100.0
New York	5,445,937	42.8	22.9	7,076,860	45.6	31.7
Pennsylvania	1,243,747	9.8	9.5	1,932,348	12.5	11.8
Illinois	880,028	6.9	9.0	1,196,143	7.7	8.4
California	494,761	3.9	5.4	385,613	2.5	4.0
Massachusetts	670,313	5.3	5.4	835,573	5.4	8.2
Ohio	354,511	2.8	4.5	549,997	3.5	4.5
New Jersey	338,565	2.7	3.7	378,191	2.4	3.4
Missouri	287,876	2.3	3.3	369,182	2.4	2.8
Total	9,715,738	76.4	64.1	12,723,907	82.1	74.8
Other states	2,995,322	23.6	35.9	2,781,325	17.6	25.2

TABLE XI.

INCOMES AND TAX RECEIPTS BY GEOGRAPHICAL DIVISIONS, 1913.

Area.	Incomes Subject to Normal Tax.			Incomes Subject to Supertax.		
	Tax Paid.	Per Cent. Distribution.		Tax Paid.	Per Cent. Distribution.	
		Tax Paid.	Number of Incomes. See Table IV.		Tax Paid.	Number of Incomes. See Table IV.
United States	$12,711,050	100.0	100.0	$15,505,232	100.0	100.0
The North	10,506,759	82.7	74.5	14,093,115	90.9	83.1
New England	1,020,403	8.3	9.0	1,432,973	9.2	12.8
Middle Atlantic	7,028,249	55.3	36.3	9,387,399	60.5	46.8
East North Central	1,778,710	14.0	19.2	2,621,603	16.9	17.3
West North Central	679,397	5.3	9.9	651,140	4.2	6.1
The South	1,389,525	10.9	15.6	881,661	5.7	10.3
South Atlantic	700,738	5.5	7.7	626,980	4.0	5.2
East South Central	225,242	1.8	2.9	73,883	.5	1.8
West South Central	463,545	3.6	4.8	180,798	1.2	3.2
The West	814,766	6.4	9.8	530,456	3.4	6.7
Mountain	182,308	1.4	2.2	70,011	.5	1.4
Pacific	632,458	5.0	7.5	460,445	3.0	5.3
East of Mississippi River	10,753,342	84.6	75.4	14,142,838	91.2	84.0
West of Mississippi River	1,957,708	15.4	24.6	1,362,394	8.8	16.0

Table X shows that New York and Pennsylvania, of all the states named, pay a larger proportion of the normal tax than their proportion of the total number of incomes. This points, of course, to larger average incomes than elsewhere. In like manner these two states pay a larger percentage of the supertax than their share of the number of incomes subject to such tax. It is, however, both as respects normal tax as well as supertax, only in the case of New York that the discrepancy is marked.

Table XI showing geographical divisions, emphasizes the fact that tax receipts not only for the normal tax but especially for the additional tax, are more concentrated in the North, and particularly in the Middle Atlantic section, than are the incomes subject to taxation.

The total receipts for the first ten months' experience in the tax were, as has already been stated, upwards of $28,000,000. It may be noted that for the year 1914 the Secretary of the Treasury estimates the receipts from the personal income tax at $40,000,000. At the first blush it might seem that the estimated increase was somewhat excessive but there are several factors which enter into the probabilities of the case. Some of them are indicated by the Secretary of the Treasury, and others are not mentioned though doubtless they contributed towards forming his judgment of the probable income.

There are at least six factors which would lead us to anticipate greater receipts from the personal income tax in 1914 than in 1913:

1. The tax in 1914 will affect the whole year's income and this in itself would account for an addition of one fifth to the receipts were no other persons taxed than those who made returns in 1913.

2. The returns for 1914 will include the income for January and February of that year, months which were omitted in 1913 and also months in which certain kinds of income, especially receipts from interest upon securities, are abnormally heavy.

3. The system of taxation at the source will be in full vigor in 1914. Apart from the fact that this may lead to a more ac-

curate ascertainment of incomes, there can be no doubt that such taxation at the source will affect the incomes of persons not really subject to taxation because of the failure of large numbers of persons who are receiving income in comparatively small quantities from interest on securities to make the necessary declarations of exemption.

4. With the natural growth of population, other things being equal, a larger number of persons would probably be subject to the income tax in 1914 than in 1913.

5. The tax for 1914 will probably be levied more fully than in 1913 and the evasions of the tax, either through willful tax dodging or through ignorance of the law, will be less frequent.

6. As the incomes for the year will be larger, they will, so far as the additional tax is concerned, often be subject to taxation at higher rates. Thus a person whose income in 1913 was exactly $20,000 was not subject to the additional tax, but his income for 1914 will be at least $24,000 and the excess over $20,000 will be taxable at 1 per cent.

As a partial offset to these various factors which will tend to increase the productivity of the income tax in 1914 as compared with 1913, we must take into account the fact that the general condition of business was less prosperous in 1914 than in 1913. That this element will have some effect can hardly be doubted although the extent of its influence is not susceptible of measurement.

From the meagre and incomplete figures which we have attempted to analyze in this paper, the most obvious conclusion is the need for far more complete information in regard to incomes and the income tax than we now possess. Returns for the year 1914 are now in the hands of the internal revenue officials. Let us hope that next year the Commissioner of Internal Revenue will tell us what these returns really contain. The system of taxation at the source will be in full vigor and new and interesting questions will arise which can only be answered by a much more detailed analysis of the figures. There seems to be no reason why the public should not know for each income class not only the number of persons included in it, but also how many are single, how many are married, what is the amount of exempted income, what the amount of

dividend income, what the amount taxed at the source, the amount of taxable income and the product of the tax. Such an analysis would be easily derivable from the income tax returns. If the information given is to be valuable, considerable attention must be given to taxation at the source, and salary payments should be distinguished from interest payments. If this is done we should be able to distinguish income from salaries and similar sources, that from dividends and that from interest. Furthermore it would seem a comparatively simple thing to ascertain revenues from business undertakings.

There are also some special questions on which the public is entitled to information. One of them concerns particularly the income received from dividends. Such an analysis of the net income of corporations as would show how much of this income is distributed in the form of dividends, is highly desirable. It is also important to ascertain how much of such dividend income goes to other corporations and is taxed again through their income tax, and how much of it goes to individuals. If the latter point were ascertained and the declarations of the individual income tax properly tabulated, we should be able to see how much of the tax on the dividends falls upon those persons who are liable to income taxation, and how much falls upon persons who are not so liable, either because their income is less than $3,000 per annum or because they are educational and other institutions exempted from the payment of the tax. A further question which will be of particular interest in the coming year, when the system of taxation at the source is in full swing, relates to the payment of interest by corporations. Under the law the tax on such interest must be paid at the source unless there is filed for the individual recipients declarations of exemption. It is undoubtedly a fact that a considerable number of holders of small amounts will not file such notices of exemption and that consequently so far as the interest on the securities is concerned it will really be paid for persons who are not subject to the personal income tax. If the amount of tax paid at the source by corporations should be compared with the aggregate interest noted in the individual returns as taxed at the source, we

should then be able to ascertain how far the former exceeded the latter.

These are simple illustrations of the kind of information which could be derived from the income tax returns if they were properly systematized and presented to the public. They are in fact a veritable mine of economic information, but it is a mine which needs to be worked. Surely the government must have at its disposal the advice of expert economists and statisticians who could show what facts ought to be presented to the public, and how the material should be analyzed to obtain such information. Unless appearances are misleading, the Commissioner of Internal Revenue did not seek such advice in preparing his first report. With a full year's returns for 1914, and with the system in complete operation, it is to be hoped that these problems will receive more adequate attention.

OLD AGE AND THE INDUSTRIAL SCRAP-HEAP.

By Arthur J. Todd, *University of Pittsburgh.*

The problem of "dead weight" in a population is one of the most delicate questions in the whole range of social economy. Statisticians commonly reckon as dead weight, or *bouches inutiles*, children under 15 and adults over 60. National morality, no less than national productive capacity, is to be measured by the general treatment accorded these age groups. Primitive men settled the matter rather summarily by infanticide, killing off the aged, or "reasoned neglect." Andrew Lang once described in his own inimitable way how some savages used to put their old gentlemen up in trees, and then after singing "the fruit is ripe!" shook the trees and clubbed the aged unfortunates as they tumbled down. Incidentally he expressed the hope that America would not revive the custom!

The storm of indignant protest which greeted Dr. Osler's Johns Hopkins address indicated that we are by no means ready to grant that men have outlived their comparative usefulness at 40, or have become utterly useless above 60. Trollope's earlier sentence of painless extinction for the elderly person was repudiated no less roundly. And that the protests were not mere spasms of sentimentality is proved by the stores of facts brought forth to show what the world would have lost in nearly every field of human activity had the Osler suggestion been taken seriously. Dexter, for instance, showed that eminence in twenty fields was reached only at a median age of 54. The average distribution of all persons below 40 in a company of 6,983 *Who's Who* eminences footed up only some 16 per cent. There is little doubt that longevity is increasing; we have good reason to believe that the average lease of life has doubled in the last three hundred years. But that is not all: The level of old age also is rising. Doctor Johnson suggested 35 as the point after which a man's steps turn down hill; and Montaigne retired at that age to meditate as became

an elderly gentleman. Both Dante and Sir Walter Scott spoke of old age coming at 55. But on the other hand Sir James Crichton Browne tells us that life owes every man and woman a hundred years, and that it is their business to see that they collect the debt. And William James hinted at the true definition of old age when he declared that one might become an old fogey at 25, but went on to do perhaps his own most significant work after 60.

The more specific problem in hand is, What evidence exists of a generally recognized upper age limit of economic efficiency? This is the substance of the oft-repeated question, What becomes of the worker over 50? Is there any evidence that modern industry is "scrapping" its workers at an unduly early age, or is using them up any more rapidly than formerly? And if industry finishes with them, say, at fifty or sixty, what becomes of the wreckage?

It must be admitted at the outset that the materials for answering these questions are widely scattered, and not by any means always satisfactory. Several statistical difficulties intervene. In the first place, there is a tendency to misrepresent ages either by under or over-statement, according to some fancied possible advantage. It is significant for our problem that more persons return themselves as younger than as older than they are. There is also liability to error in reporting persons as occupied or unoccupied. A man of 65 may report himself as occupied when in reality his employment may be of the most casual sort; he may be underemployed or sweated, and his earnings may be quite insufficient for his maintenance. Again, Census reports give only the sparsest details, too few for full comparison. And special studies like Booth's of London or Rowntree's of York are fragmentary or limited in area and time. Also increasing longevity complicates the problem and makes statistical comparisons difficult.

According to the Census of 1910 the male population of the United States above the age of 50 totalled 6,770,392, distributed as follows: Age 50–60, 3,598,450, or about 53 per cent.; age 60–70, 2,049,960, or about 30 per cent.; age 70 and above, 1,121,982, or 17 per cent. If we compare the numbers

in the several age groups with the total population it appears that age 50–60 contains 7.2 per cent. of the total population; age 60–70, 4.3 per cent.; age 70 and over, 2.3 per cent.

The economic status of these age groups is hard to discover from census returns. We know, however, that a considerable plurality of the population 45–64 live in the country, either as farm owners, tenants, or laborers; that a still larger proportion of those 65 and over are rural dwellers; moreover, that the owners of farms quite overtop tenants in the ages 55 and over. The lower rural death rate would account in part for the accumulation of the aged in country areas; but there is usually also a certain tendency for the worker caught in the modern city-ward drift to seek the country again in his old age. From statistical estimates occasioned by social insurance and pension proposals some further ideas may be gleaned. Congressman Berger in his speech before the House, 1911, declared that a pension scheme for needy persons over 60 would have to reckon on 2,675,000 individuals; but there seems to be no sound evidence for quite so high a figure. F. L. Hoffman, a keen critic of old age pension schemes, estimated in 1908 that 1,786,161 persons over 60 would be entitled to pensions. L. W. Squier stated in 1912 that approximately 1,250,000 former wage earners 65 and over are in want and supported by public or private charity. The Massachusetts Commission on Old Age Pensions (1910) found in that state alone about 12,000 persons 65 and over, exclusive of public paupers, eligible for pensions. The figures run somewhat higher for England. Hence the presumption that for some reason or other a large number of persons over 60 years of age are more or less dependent.

Only a small part of them are in charitable institutions. The special census report on paupers in almshouses in 1904 accounted (on December 1, 1913) for only 37,143 males over 50, of whom 28,075 were over 60. It revealed, however, that the average age admission of all males was 51 years. A similar census report for 1910 enumerated 43,101 males over 50, of whom 31,179 were over 60. While the general almshouse pauper rate has steadily declined for the last thirty

years (from 1,320 per million of the population in 1880 to 915 per million in 1910), the increase in age groups 55–80 has been marked during the last ten years. This increase is not necessarily due to admissions out of proportion to the general increase in population; it may result in part from an accumulation of the higher ages through increasing longevity—a phenomenon accountable also in part for the apparent increase in the rate of insanity. Between 1904 and 1910 the almshouses added 13.4 per cent. to their numbers aged 55–80: men increased 18 per cent., women 7 per cent. Comparing the numbers admitted during the census year, it appears that the totals for 1910 exceeded those of 1904, ages 55–80, by 12 per cent.: men increased 17 per cent., women fell off 7 per cent. Lest these figures gather undue significance, let us hasten to add that the decennium 1900–1910 swelled the general population by nearly 2,000,000 persons between 55 and 80, a gain of 27 per cent. Only a trifle over 1 per cent. of the total population over 65, and considerably less than 1 per cent. of those 55 and over, are in public almshouses. Hence it is obvious that if dependence is on the increase in these age groups it is being cared for outside the public almshouses.

If we turn to the census reports on private "permanent homes" presumably for the aged, the number of male inmates shows an increase from 54,800 in 1904 to 59,677 in 1910. This gain is not proportionate to the increase in the general population in its higher age groups. It may very well be that the United States is sadly deficient in institutional homes for the aged respectable poor, or for those with slender incomes. For in spite of the fact that such homes increased by nearly 20 per cent. in the last decade, it is still true that after deducting the inmates of Soldiers' Homes, private charitable homes in 1910 were caring for only 22,094 men, presumably superannuated.

Nor do institutions for the care of insane and feeble-minded indicate any striking increase in the care of aged defectives. In 1904, 32,995 males over 50 were found in insane hospitals; in 1910 the numbers rose to 34,999, an increase of about 6 per cent. as compared with a gain of over 28 per cent. in the

general population aged over 50. As to the feeble-minded over 50, their numbers are quite negligible, a bare 250 for the country as a whole. Perhaps not more than 2 per cent. of all the institutionalized feeble-minded run over 50. Even assuming that only one tenth of this class of dependents are institutionalized, their total in the general population is not formidable. And, indeed, this whole class is more or less negligible when one is considering the fate of the normal superannuated worker. For at best the feeble-minded man occupies only the most casual place in the industrial mechanism.

Among tramps the larger proportion are under 50, perhaps even under 30. But a considerable number of so-called "homeless men" are over 50, if we can judge by Mrs. Solenberger's study of a thousand typical representatives of this class; and most of them, whatever their original trouble, gravitate to the cheap lodging houses of large cities.

The charitable agencies account for another superannuated group. From the records of Charity Organization Societies in the United States the factor of old age as a determining cause of poverty seems to run from 3 to 6 per cent., as compared with nearly 30 per cent. for certain sections of London, and about 15 per cent. for some 76 German cities. But as the American figures do not include cases of unemployment due to old age, the discrepancy may not be so large as might at first appear. Miss Goodyear's study of 5,000 dependent New York City families developed the fact that nearly 12 per cent. had heads 60 years old and over.

No definite figures can be cited to show the sources of income for these more or less dependent families and elderly individuals. A comparatively small number, as we have already indicated, are housed in various types of public or private institutions. Some live off their accumulated savings. But their number must be relatively small, for three reasons. First, admitting the optimistic claim that real wages have increased in the last two or three decades, it is quite probable that the increase has gone to the bettering of living conditions rather than into savings. Second, statistical studies of workingmen's budgets show a striking lack of income-surplus which might be con-

verted into savings accounts or old-age annuities. Mrs. More's figures covering 200 New York families in 1907 showed a substantial surplus only when the income exceeded $1,000. But as only about one tenth of American wage workers earn over $1,000 a year, Rubinow is apparently quite within the truth when he concludes that a surplus of $50 per annum is not at all a common occurrence among wage-earners. Third, such meagre studies of savings banks as we have confirm these conclusions. In typical Massachusetts savings banks within reasonably recent times the average deposit of working people was less than $75. Rubinow's analysis of Connecticut savings banks does not tell a substantially different story. These banks show a 300 per cent. increase in total deposits and a 200 per cent. increase in depositors during the last thirty years. But since 85.3 per cent. of all depositors had less than $1,000 each (and unless the figures for 1880 have changed miraculously, three quarters of this group averaged less than $500 each), and since only one third of the total deposits were held by the small-depositor group, it may well be that workingmen's deposits represent only one third of the total. As a matter of fact their average deposit seems to have increased from $190 in 1880 to $202 in 1910, a gain of 7 per cent. as compared with an increase of 22.9 per cent. in the average deposit of the so-called richer groups. From the standpoint of sharing in the total increase of deposits it must further be noted that while the total number of depositors in general hardly tripled, the number of those having accounts over $2,000 more than quintupled. Or, stated otherwise, during the thirty years in question the group of smaller depositors dropped from 46.5 per cent. to 37.5 per cent., while the larger depositors rose from 19.9 per cent. to 37.5 per cent. of the total. Hence on the whole we get little encouragement from savings bank returns. And there is little evidence at hand of any very wide use of the "stocking" or the "chimney" as a hoarding place outside the banks.*

* Returns from the United States Postal Savings Banks bear out this general conclusion. Notwithstanding the recent large increase in deposits and depositors, due in part to the cessation of remittances to Europe brought about by the war, the average deposit on Jan. 1, 1915, was only $119.

Private charity and public out-door relief constantly take care of many thousands of the aged poor; but exactly how many nobody knows. Squier, using Massachusetts figures as a basis of computation, estimates the number at about 150,000. We are on somewhat surer ground in estimating aged United States pensioners. According to the report of the Commissioner of Pensions for 1914, pension claims up to June 30, 1913, under the Act of 1912, were admitted from 395,750 survivors of the Mexican and Civil Wars. Their ages ranged from 62 to 103, with an average of 70.7 years. 8.1 per cent. were between 62–65; 34.7 per cent., 66–69; 35.7 per cent., 70–74; 21.5 per cent., 75 and over. These figures practically exhaust this class of military pensioners.

Various other types of public or private pensions granted by municipalities and by perhaps fifty notable industrial and transportation corporations ease the lives of several thousands of those whom old Fuller quaintly called "industries martyrs." A favored few have been able to save enough to buy annuities. Some, comparatively few, however, receive trade union superannuation benefits. A large number depend upon relatives and family friends.

Perhaps all except the well-to-do, the lazy, and the incapacitated add by their own labor to these rather slender sources of income. The census returns for both England and the United States tell something of the employments of the elderly. Out of every 100 males in gainful occupations at the United States Census of 1890, 13.5 were aged 45–54; 8 aged 55–64; 5.3 aged 65 and over. Between ages 20–65 more than nine tenths were employed; and even after 65 nearly three quarters reported themselves as occupied. But from 1890 to 1900 in every age group above 25 the proportion of males gainfully occupied dropped. In 1890, 96.6 out of every 100 males aged 45–54 were occupied; in 1900, only 95.5. Ages 55–64 dropped from 92.9 to 90 out of the hundred; ages 65 and over, from 73.8 to 68.4. The Census of 1910 is exceedingly unsatisfactory on this point: It gives no age classification over 45. The only information we can glean from its slender tables is to the effect that in 1900, 87.9 per cent. of all males over 45 were employed, while in 1910 only 85.9 per cent. returned

themselves as gainfully occupied. English experience seems parallel. The proportion of all persons over 65 gainfully employed fell from 64.8 per cent. in 1891 to 60.6 in 1901.

The United Census further shows that some kinds of elderly persons are better off than others. Foreign born whites over 55 showed a much smaller percentage at work than native white or native parentage in the same age groups. And negroes work to higher ages than any other class, probably because few of them acquire a competence enabling them to give up work as they approach old age, and because of their traditional horror of the poor-house. The foreign born utilize relatives and other sources of relief probably somewhat earlier than the native; among them, too, the habit of mutual aid societies and other coöperative relief agencies is stronger than with the native American.

The type of occupation claiming aged workers is of considerable significance. At the Twelfth Census, of all workers aged 45–54, more than 40 per cent. were in agriculture; 4 per cent. in the professions; 13.6 per cent. in domestic and personal service; 17 per cent. in trade and transportation; and 24.9 per cent. in manufacturing and mechanical industries. At ages 55 to 65 and above, the proportion of agriculture increases strongly; the professions slightly; while in each of the other occupations the numbers drop considerably. Stated in another way, it appears that workers 55 and over constituted 15 per cent. of all those engaged in agriculture, 15 per cent. in the professions, 10.5 per cent. in domestic and personal service, 9.5 per cent. in trade and transportation, and 10.6 per cent. in manufacturing and mechanical industries. While it thus appears that a considerable proportion of workers of the upper age groups still hold their places in industry, it must be recognized that their proportion is decreasing. The decline is all the more marked if we add here again the fact of the large increase in these ages in the general population during the last two decades.

How shall we account for the discrepancy? Is it due to the speeding-up of industry which wears out workers and "scraps" them earlier than formerly? Or is it due to increased average well-being that enables the worker to retire be-

fore having fulfilled the ideal working period of fifty years? Or does indiscriminate charity curtail the worker's self-respect and incidently his working life? Perhaps all of these and other causes conspire to cut the ideal working period from fifty to forty years and even less. Assuming that the average working period should lie between the ages of 15 and 65 (personally I should not make the lower limit in any case below 16), out of every 1,000 males living at age 15 only 444 survive until age 65; 556 fall out as the result of accident and disease. Hence, owing to largely preventable causes, more than half society's working force is dissipated all too early. The mortality rates in certain dangerous trades are indecently high and bear no less upon men under 50 than upon those above. Indeed, in some of these occupations it is comparatively rare to find a man over 50 actively employed. To illustrate: Among Solingen cutlery grinders only 85 out of 1,250 men reached 45; 458 in every 1,000 English steel-grinders die between 35 and 55; only 140 out of every 1,000 grinders attain 55, as compared with 391 in the general population; French slate miners reach an average age of only 48; French mill-stone makers rarely live beyond 45; the same is pretty generally true of housepainters. Among those that survive the mortality rate is still higher, from three to six times higher, than in general industry, agriculture, or the professions. Moreover, many of those who succeed in slipping through the hazards of such occupations are incapacitated after 50 for work in other trades; they drift into hospitals, almshouses, and kindred institutions.

But does general industry, too, use up its workers abnormally? Here the evidence is conflicting. The charge that changes in industry tend to displace the elderly workman is not new. British official studies of unemployment in 1839, 1848, 1850, and 1894 all echoed the same cry that spectacles and grey hair debarred men. The Minority Report of the Poor Law Commission said in 1908, "We suspect, indeed, that the same thing has been alleged ever since the master-craftsman, himself producing and selling his own product, was replaced by the capitalist hirer of labour."

There is good reason, however, for not dismissing the charge

with a wave of the hand. Several English economists and students of social conditions are emphatic in their belief that, as Charles Booth declared, "Modern conditions of industry do not favour the aged. Work is driven faster, and needs more nerve, and its changing methods continually displace the old." Professor Alfred Marshall, Professor J. A. Hobson, Mr. Harold Spender, Mr. Chiozza-Money, and Mr. Percy Alden, to name only a few, are of like opinion. Mr. Chiozza-Money holds that 55 is the "limit of full earning capacity for the average skilled workman. After 55 he is in the greatest danger of dismissal, when work becomes slack. . . . Each grey hair is a deadly enemy to his livelihood." Hobson alleges that progressive underemployment of the middle-aged marks the entire field of industry.

Parallel complaints are heard in our own country. We are assured that scarcely a railroad of any considerable importance will give a worker employment after he has passed 45. Other industries fix the age limited at 40. The meat-packing industry, at least until 1901, by using pace-makers so speeded-up its workers that they were "in a sweat all day, exhausted at night, and useless after forty years of age." An authority on the steel industry, particularly in western Pennsylvania, speaks of the "speeding-up system unparalleled in its effectiveness" of the big, up-to-date rolling mill. He gives no definite figures, but assumes that a twelve-hour day and seven-day week produce old age at 40. President F. A. Vanderlip of the National City Bank of New York told the National Conference of Charities in 1906 that the result of an inquiry among many hundred large American business corporations showed that "most of the employers. . . . regretfully acknowledged that it takes but a few years to use up a man, so high is the pressure at which work is now done." An engineering writer warned his brethren not long ago that it was becoming dangerous to get on the shady side of 40. "Not only is the 'dead line' an established fact in industry; but it is being drawn closer and tighter. A few years ago 45 was considered the limit of the average man's greatest productive efficiency. Forty, and even less, is now regarded as the critical point." It must not be overlooked, however, that

this same writer noted signs of a reaction in the upward direction.

This evidence must be faced with certain contradictions. Rowntree and Lasker, for example, found that in York, England, there was no question of a man's being too old at 40 in the building trades; a man of 60, if a good worker, stood an equal chance with his younger brother. It must be confessed that in other trades they stood less advantageously. The printing trades in England seem fairly favorable to the elderly. Many compositors in newspaper offices still earn fair wages at 65 or even later. The experience of various Friendly Societies shows that a very considerable number of their members over 65 are at work and earning fair wages, especially in rural districts. England's greatest authority on unemployment concludes that the influence of advancing years is not always unfavorable; and that there are some sorts of work at which men continue to gain more skill almost to the end of life itself. This was ably brought out by Booth in his study of London occupations. The lighter, more highly skilled trades, or those that are decayed or decaying, hold excessive proportions of elderly workers. There were also signs that in such trades as silk-weaving, rope-making and clock-making old workmen are retained in spite of the introduction of new machinery. The machinery admits youth-labor; men 25–45 are missing; but the old hands linger on.

In the United States it is by no means the universal practice to discharge aged workmen. It seems even less customary in the East than in the West, probably because of the predominance of skilled trades in the East. Many companies do not discharge skilled employees because of age, but place them on less skilled jobs until pensionable. Indeed, many employers consider men from 45–60 their greatest asset: because they are freer from risk of accident, have learned their trade thoroughly, have matured their judgment, and perhaps we ought to add, have grown conservative and less militant for the "rights of labor." For these reasons they are a more stable labor force, tend to reduce overhead charges, and are less wasteful of materials.

The average superannuation age gives some hint of this

policy. In the general skilled industries it runs from 55 to 65; in the meat industry 55 to 60; in the iron and steel corporations, express and public service corporations, etc., it varies from 55 to 70. The railroads as a rule set 65 for voluntary, and 70 for compulsory retirement; but train and track men may be retired five years sooner. The retiring age for policemen varies from 50 to 65, but depends rather upon length of service or incapacity than upon absolute age. Firemen are pensioned usually at 50 to 55, but here again it is largely a question of length of service. Trade unions in Great Britain that have attempted any old age benefits have pretty uniformly provided that they shall begin at 60 to 65. There is good reason to believe that in some cases at least the superannuation age is rising, despite popular opinion to the contrary. European governmental pension laws allow old age benefits to begin at from 58 to 70 years of age, with a strong tendency to fix 60 to 65 as the normal. Many European cities pension incapacity or compulsory retirement at 60 to 65.

Such age statistics of unemployment as we have, tend to show at least that the common belief in displacement by reason of age remains to be proved. In McLean's study of 720 charity cases where unemployment was alleged as the cause of need, 5 were found to be the result of being crowded out by younger men, 5 the result of old age; 12.6 per cent. of the 496 "genuine" cases of unemployment were over 50 years old. But nearly a third of the total were unskilled workers, with no apparent connection between age and employment. In England practically every reliable recent study of unemployment has shown that unemployment is not so severe among the old. Of all the qualified applicants to Distress Committees in England and Wales, 1907–8, less than 17 per cent. were over 50, while nearly 80 per cent. were between 30 and 50. In York about the same time 88 per cent. of the "regular workers" unemployed on a given day were under 50; 53.2 per cent., under 30. Poor Law returns for the whole of England in 1907 showed that 30.2 per cent. of all applications to Distress Committees were under 30. Hence one may with perfect good grace accept Sir H. L. Smith's dictum that "the chance of unemployment is a function of age"; but with

the reservation that the dangerous age is under 40 rather than, as he thinks, over 50.

Indeed, it is pretty evident that it is not so much the aged as the ill-endowed and ill-educated who in the language of the Poor Law Commission are "very like superannuated fishing boats, drawn up on the shore, and only put in the water at times of exceptional takes." An indirect proof of this comes from the fact that the greatest percentage of workhouse inmates over 10, in the British Census of 1901, were general laborers of various unskilled types. United States Census returns on almshouses are not widely dissimilar. If we compare the occupational groups from which male paupers report themselves as coming, it would appear at first sight that while from 1904 to 1910 the laboring and servant class dropped from 38.8 to 30.9 per cent., the mercantile and trading group increased from 1.9 to 3.2 per cent., and the manufacturing and mechanical industry group rose from 23.6 to 28 per cent. of the total male almshouse population. The clerical, professional, and outdoor labor groups remained stationary. The superficial inference would be that the almshouse is claiming a larger proportion of skilled workers and small traders. But the figures must be taken with reserves. First, because there is no way of checking up whether the men have reported truthfully their past occupations; and second, because the census schedules may so re-classify the various occupations that the resulting groups are not strictly comparable. This would be particularly true of such a heterogenous group as "common laborer"; and it is precisely this group that shows the greatest variation between 1904 and 1910. In any event the unskilled classes still predominate among almshouse paupers. The census gives no correlations between past occupation and present incapacity; all we know in this connection is that about 54 per cent. of all the male almshouse paupers enumerated on January 1, 1910, and about 57 per cent. of all those admitted during 1910 were either able-bodied or able to do light work.

On the whole, then, the chief reason for unemployment among casual laborers is not age, but sickness, inferiority in capacity, push, enterprise, and ability to make a good impres-

sion. The latest study of vocational unpreparedness concludes that "Useless at 25" is the menacing prospect which faces English boys who leave school at 14 to enter blind-alley and unskilled occupations. It is pretty safe to assume that a similar observation holds good for the United States. Hence we must add that unemployment is a function of native endowment, of training, of good temper, and perhaps of other variables besides mere age.

While in general it is true that old age may not cause a worker's discharge, it may prevent his getting a new job if for any reason he loses his place. Sentiment or appreciation on the part of employer as the result of long acquaintance may incline him to retain an aged worker long past the period of his full efficiency; but the same motives do not operate in a strange employer to constrain him to hire an elderly applicant, however worthy. Long continuous employment with one firm is apt to render a man peculiarly helpless when that firm winds up its business or goes bankrupt and discharges him. Such cases are among the most distressing of all the unemployed. Acute discouragement, despondency and an abnormal mortality rate frequently result. The economic principle of mobility of labor constantly breaks down here in practice. Transferability of labor is not very great even for younger men, and is probably still less for the elderly. With the current lack of vocational training and guidance scarcely more could be expected. Mr. H. G. Wells and others have proposed schemes for rotation in employments to secure "inter-occupational mobility," but so far nothing definite has been accomplished. It is certain that in this respect at least the elderly are at a disadvantage.

Trade unions have been charged with injuring the occupational chances of the aged, through strict insistence upon a standard rate of wages regardless of individual capacity. Such a principle would no doubt bear heavily upon the old. But it is not adhered to with rigor. In both England and America many of the unions make express exceptions in favor of members over 55–60, allowing them to work at any rates they can get, or at rates to be approved by their unions. Many unions, too, which have no formal rules on this subject

allow informal exceptions. In general there is no danger to the unions in such practices, provided their standard rate has become firmly established. And there is a positive advantage in that it relieves their superannuation and benefit funds. Still other unions, notably the London Dock Labourers, do not allow elderly members to work at less than the standard wage, but favor them by encouraging the younger men to step aside that the old "may have a turn."

Wide differences of opinion prevail as to the effect of Workmen's Compensation Acts upon early retirement of workers and upon their chances of reëmployment. Judging upon the evidence at present available, I have come to the general conclusion that they have not worked seriously to the older man's disadvantage. Much current opinion to the contrary can be traced to mere excuses given by employers for laying off men, or by loafers among the unemployed for being without a job. It is extremely easy, too, for an inmate of the almshouse or workhouse to charge these laws with his difficulty, when in reality it was largely misconduct or maladaptation. English poor law officials fail to find many cases of men driven to the workhouse on this account. In general the accident insurance companies transacting workmen's compensation business in ordinary industries make no restriction or stipulation in the contract of insurance with regard to old men or men past middle life. The reason is that elderly men have not proved worse risks than the younger. Many studies show that quite the reverse is true, and that the age-group 25–30 rather than 50 is the danger point from the standpoint of employers under these Acts. The same mature judgment that makes the older workman economical of his employer's materials induces caution, and saves him from taking undue risks. It may be that it is too early to judge of the final effects of compensation laws; it may be that they will tend to work cumulative hardship upon the aged, especially those who are more or less physically disabled by reason of defective constitution or accident. But the point remains that those who argue from this assumption either directly against compensation laws in general or indirectly through asking that defectives be allowed to waive compensation provisions

have not yet produced the necessary mass of statistical fact to support their case or to justify a tenable scientific conclusion.*

Finally, the charge is made against scientific management and the efficiency experts that they tend to speed-up workmen, deplete them, and displace them early. It is indubitable that many of the earlier pronouncements of efficiency experts made it seem that scientific management regarded workmen as mere machines to be worked to the limit. They may have disclaimed any such intention, but certainly they failed to remove the adverse impression. Fortunately they have begun to recognize that men are more than mere reservoirs of energy, and that, for the very scientific administration of business itself, workmen must be conserved rather than driven. Mr. Brandeis in his vigorous defense of scientific management denied unconditionally that it either speeds-up or throws men out of employment, or that it even displaces the inefficient. To the contrary, he claims that it helps the inefficient most, because "it supplies instruction, and offers to the teachers special incentives if they succeed in bringing up the hindmost." Now such phrases may be only pretty statements of policy rather than of realized fact; but it is quite apparent that the basic idea involved therein is gaining ground and may be counted on to offset whatever real damage scientific management as an industrial policy may have done to aged workers.

It is a matter of regret that the paucity of statistical data

*It is only fair to state that Miss Coman in a somewhat cursory discussion of the English Insurance Law of 1911 alleged that "bad risks" were being discharged, thus lengthening the period of old age incapacity in England. (See, *Survey*, Feb. 21, 1914, p. 640.) Mr. Francis Feehan of the Pennsylvania Department of Labor and Industry tells me that this is also probably true of America, but that it is not to be considered as serious. The American Federation of Labor at its thirty-fourth annual convention (1914) went into this matter at considerable length. Reports of various delegates showed that, particularly in New York, discrimination on this score was feared by labor leaders. They based their chief arguments against the discriminatory physical examinations upon the fear that men would be rejected as bad risks *not so much because of age as of labor union affiliations*. The discussion centered around Delegate Dujay's Resolution No. 50 which read, in part: "*Whereas*, this scheme of physical examination is detrimental in the extreme to labor, in that it provides a means by which the employers may eliminate from employment all workers whom they might deem it to their interest to eliminate; and, *Whereas*, it is usually to the interest of the employers to remove from their employment the active members of organized labor. . . . *Resolved* that this convention go on record as insisting on our affiliated national and international unions refusing to permit their membership to stand for any kind of physical examination as a consequence of the said compensation law or any other compensation law. . . ." In general it would seem that such discrimination is really a pretext rather than a genuine disability.

precludes a categorical answer to the problem proposed in this paper. But this negative or exceedingly provisional result may stir up somebody to the point of providing more adequate materials. Meanwhile we may conclude that on the whole the elderly worker suffers from lack of vocational training and lack of means for replacement after displacement from an employment long held, rather than from mere age. Old age is frequently only a cloaking phrase for incompetency. In the skilled trades he is better off than in those occupations which simply exploit crude muscular power. The mere introduction of new machinery does not necessarily militate against him, and may actually favor him. Neglect of proper safeguards against accident or disease and in some cases undue speeding-up tend to wear him out too early; but many business men are beginning to realize that this is a suicidal and uneconomical policy. Current social philosophy voices the belief that the ordinary man ought to be preserved for a productive period from the ages of 16 to 65. Pension, superannuation, or retiring allowances tend to fix on 60–65 as the age at which a man should be relieved from full participation in industrial activity. We observe with regret, however, that an undue proportion of men above this age, and even under it, are still dependents or derelicts. Theoretically many people hold that the counsel to give up work at 60 is a medical fallacy, and that any trade which even tends to "scrap" its workers before that age is an economic and social menace; but much remains yet to be done before these principles are fully actualized.

ESTIMATES OF A LIVING WAGE FOR FEMALE WORKERS.

By Charles E. Persons, *Associate Director of the School for Social Economy, Washington University, St. Louis, Mo.*

Nine of the American states have recently passed minimum wage statutes for the benefit of women workers.* In more than that number there are strong and well-organized groups seeking similar legislation. The growing strength and progress of this movement makes the question, What is a living wage for women workers? one of immediate practical importance. In the phraseology of the statutes passed, we have definitions of a minimum wage as viewed by our law-making bodies. The Oregon statute requires wages adequate "to supply the necessary cost of living and maintain health." The California act reads "the cost of proper living." In Wisconsin a living wage means compensation sufficient to enable the employee to maintain herself under conditions consistent with her welfare, and welfare is defined "to mean and include reasonable comfort, reasonable physical well being, decency and moral well being." In general the statutes clearly intend to include more than a bare subsistence wage. They have in view the standard of the Australian arbitration court, "the normal needs of the average employee regarded as a human being living in a civilized community."

Various attempts to give a definite and detailed estimate of the actual cost of living are presented in the following table:

*Since this paper was written the tenth state, Arkansas, has passed a minimum wage law.

	(1) Kentucky.	(2) Baltimore.	(3) St. Louis.		(4) Kansas City.	(5) Minnesota Twin Cities.		Wage Board for Duluth.	(6) Massachusetts.	(7) Boston.	(8) Massachusetts.		(9) Portland, Oregon.
	Week.	Week.	Week.	Year.	Week.	Mercantile.	Manufacturing.		Week.	Year.	Week.	Year.	
Food	$4.00	$3.60 [d]	$3.50	$182.00	$3.00	$4.80	$5.00	$4.90	$3.50	$169.70	$4.00	$208.00	$300.00
Rent			2.00	104.00	2.00				2.00	74.81	2.48	128.96	
Clothing	1.40	2.00	1.53	80.00	1.50	2.00	1.92	2.00	1.35	88.99	1.92	100.00	130.00
Laundry	.50	.50	.25	13.00	.40	.50	.45	.50	.20		.55	27.50	25.00
Carfare	.60	.60	.60	31.20	.60	.50	.30	.30	.60		.52	27.04	30.00
Amusement			.20	10.40		.25		.25	.09		.54	28.00	25.00
Vacation			.10	5.00		.10	.50	.20	.19				
Education						.10	.10		.08	[b] 117.06	.07	3.65	10.00
Church			.05	2.60			.15	.10	.10		.10	5.20	[c] 10.00
Insurance			.10	5.20		.06	.05	.06					
Savings										31.63			
Medical			.20	10.00	[a] 1.00	.30	.35	.38	.17	22.09	.42	22.09	15.00
Incidentals						.04							
Total	$6.50	$6.70	$8.53	$443.40	$8.50	$8.65	$8.82	$8.69	$8.28	$504.28 $10.00 per week.	$10.60	$550.44	$545.00

(1) Kentucky, Report of Committee to Investigate the Condition of Working Women, 1911, p. 5.
(2) Baltimore, Miss Butler's "Saleswomen in Mercantile Stores," 1912, p. 115.
(3) Estimate of the School of Social Economy of Washington University.
(4) Kansas City Report on Wage-Earning Women, 1913, p. 80.
(5) Minnesota, First Biennial Report of the Minnium Wage Commission, p. 37.
(6) Massachusetts, Statement and Decree Concerning the Wages of Women in the Brush-making Industry, August, 1914, App. No. 1.
(7) Boston, Miss Bosworth's "Living Wage of Women Workers," 1911, p. 11.
(8) Massachusetts Commission on Minimum Wage Boards, 1912, Appendix D., p. 222.
(9) Oregon, Report of the Social Service Committee of the Consumers' League, 1913, p. 67.
[a] Incidentals, sickness, unemployment. [b] Miscellaneous.
[c] Lodge and church dues. [d] Board and Lodging, $3.00. Luncheon, 60 cents.

Examination of the preceding table shows that estimates of the necessary cost of living for the women workers have varied from a minimum of $6.50 per week, to a maximum of $10.60. The estimates fall into three clearly marked groups: Those of $10.00 or more; those less than $7.00; and those near the estimate of $8.50. The estimates below $7.00 "represent the cost of living at the subsistence level," not a living wage. They include only a minimum provision of food and lodging, clothing, laundry, and carfare. The lowest estimate presented, that of Kentucky, was made by the Commission to Investigate the Conditions of Working Women in Kentucky and represents the cost of living in Louisville. It is obviously not a living wage within the meaning of our statutes. As the Commission stated: "this allows nothing for illness, recreation or ribbons." The estimate for Baltimore is taken from Miss Butler's thoroughgoing and comprehensive study of Saleswomen in Mercantile Stores. It is similar in character to the Louisville estimate in that it presents always the cost "at the minimum" and excludes all items about which debate might arise. It should be noted, however, that it is taken from a study of a single group of wage-earning women and is not a composite estimate including the costs of living of all working women in that city. This fact explains the more generous provision for clothing. It is well-known that the demands made upon the saleswoman, to present a neat and attractive appearance, necessarily result in greater expenditures on her wardrobe. The author * explains that this item "may seem large" and will only be understood if it is remembered that working women are "mediocre human material for the most part, neither very clever, nor very competent, nor very farsighted for the next season's want." "She neither knows how to sew nor wants to spend time sewing. Her leisure is precious, her weariness extreme, and it is easier to buy things." Furthermore, in following this easier way and buying things, she must often, because of the lack of accumulated funds, buy on the installment plan, "an expensive way." It will be noted that a majority of the clothing estimates, presented in the tables, are $2.00 per week.

* Butler, Saleswomen, etc., p. 115 *et seq.*

Just what such a budget signifies will be evident from some further considerations presented by this Baltimore study. The author declares: "That some money should be spent for sundries is no less essential than that some money should be spent for food. . . . But at a weekly cost of $6.70 there could be no doctor's bills, no medicine, there could be no postage stamps, and no carfare, except to and from work; above all, there could be no recreation. Life would be without social content." One must conclude that these exclusions preclude giving such a budget standing as a living wage within the meaning of our statutes. We may agree with the author that were we to maintain it "we would be attacking health and efficiency. The desire for recreation is as fundamental as the necessity for work and the desire for food. A budget which in any measure provides for a sane and useful existence must admit some expenditures other than those essential for the mechanical maintenance of physical life.*

Pass then to a consideration of the estimates at the other extreme, those over $10.00 per week. Miss Bosworth's† study of the Living Wage of Woman Workers is based upon the actual budgets of 450 Boston women. Of these budgets, 399 were complete; 37 of these were furnished by professional workers; 143, clerical; 49 were from saleswomen; 88 from women employed in factories; 64 from waitresses; and 18 from workers in kitchens. Obviously this gives undue weight to clerical workers. These women were grouped into five classes on the basis of wages earned, as follows:

(1) $3.00 to $5.00 per week;
(2) 6.00 to 8.00 per week;
(3) 9.00 to 11.00 per week;
(4) 12.00 to 14.00 per week;
(5) 15.00 and over per week.

* With these estimates of the minumum cost of living should be placed the statement in Miss Butler's Women and the Trades, pp. 346-7. The data were gathered by inquiry among working girls, settlement workers, and club leaders. "They agreed that the minimum below which a working girl can not live decently and be self-supporting in Pittsburgh is $7.00 a week. . . . The weekly outgo for food and lodging would be from $4.50 to $5.00 a week. If $2.00 a week were spent for clothing, there would at most be less than $.50 a week left for washing and ironing; for sundries, which make so formidable an item in the budgets of most of us; for illness, for medicine, for medical care, or for recreation. . . . Yet $2.00 a week is the lowest estimate for clothing made by girls who have themselves grappled with the problem at first hand in Pittsburgh."

† Bosworth, Living Wage, etc., p. 8 *et seq.*

Out of 399 workers:

51 fall in the first group;
185 in the second;
102 in the third;
36 in the fourth;
25 in the fifth.

The expenditures of the individuals in each class have been averaged and the figures presented above are the actual expenditures of the third wage group which were taken as representing the minimum living wage. The basis of the choice is stated: "This class stands midway in the wage scale and represents roughly the average of all women workers covered by the investigation. It appears, moreover, that the average income and the average expenditures of this class approximately balance each other; whereas in the two classes standing lower in the scale there is a deficit of income below expenditure, and in the two classes standing higher in the scale a surplus of income over expenditures according to the tabulated returns. This fact indicates that the income first becomes adequate to meet expenditures when this wage group is reached."

Further indication that the expenditures of this class represent a "fair minimum standard of decency and comfort" is found in the fact that the expenditures for food, rent, and health tend, in general, to rise until the third group is reached and thereafter to remain stationary or to fall. Expenditures for clothing offer a slight exception since the rise in expenditures is continued to the fourth group. Savings also are believed to point to the third group as representing the living wage. In both the lower groups average savings amount to but a few dollars a year. In the third group the average savings of over one hundred wage-earners was $31.63.

Comparison of this estimate of the living wage at $500 per year or $10.00 per week, with the detailed estimates which amount to $8.50 per week will show that the largest divergence is in this item of $31.63 for savings and in the allotment of $107.00 per year to miscellaneous expenditures. As to the first item it is very doubtful whether the statute may be con-

strued to include so large a margin for savings, however desirable it may be intrinsically. The miscellaneous expenditures undoubtedly include a more liberal allowance for amusement, vacation, education, the church, than the investigators of the subject and the wage boards have felt justified in bestowing. On the contrary, the actual medical expenditures were from $5.00 to $10.00 greater than the estimated needs. To be useful as a basis for the determination of living wages under the statutes it would be necessary to exclude from consideration the professional workers since legislation does not ordinarily reach them. The study shows this group to have enjoyed much higher earnings than the remaining occupational groups. Their inclusion, joined to the liberal provision for savings, and miscellaneous expenditures will go far to explain the difference between this estimate and those of the $8.50 per week.

The next estimate No. 8 is taken from Appendix D of the Report of the Massachusetts Commission on Minimum Wage Boards and is the result of two conferences of "some 30 social workers." It is intended to represent "what it would cost a woman of average ability, initiative, and intelligence . . . when living away from home to secure the necessary comforts of life." The item of medical expense is adopted from the study just considered and includes "dentistry, doctor's fees, medicine, and oculist's fees." There would thus appear to be some inaccuracy in the statement that no allowance is made for "unemployment, *sickness*, accident, or old age." Comparison with the various other schedules will show that this estimate is more liberal in practically every item and, aside from the manner of formulating the estimate, the explanation would seem to be that its authors were considering the necessary *comforts*, rather than the necessary *costs* of living.

The last of the estimates of over $10.00 per week is from the report of the Social Survey Committee of the Consumers League of Oregon made as a contribution to the campaign for minimum wage legislation. It is based on over 500 schedules, received from wage-earning women in Portland, supplemented by an investigation of "over 100 rooming-houses, housekeeping rooms and private families offering room and board."

The report concludes: "If we were to omit the sum allowed for recreation, $25.00 per year, we would bring the actual cost to $520 a year, or $10.00 per week for bare necessities." This, it is believed, is the very least on which the average self-supporting woman can keep herself in health and live decently in Portland, and the detailed statement is intended to present the manner in which the money would "be spent were women in all cases living as they should." Of the $300 charged to food and rent $120 is allotted to room rent. By comparison with the estimates whose sum is $8.50 per week, it appears that this higher cost of room joined to the more liberal estimate for the cost of clothing, and the vacation item account for practically all the difference shown.*

The lowest of the estimates in the middle group is that of the Massachusetts Brush Makers Board as reporting to the Minimum Wage Commission. It is noteworthy as an attempt of a board composed of employers, employees, and the public to grapple with the practical problem of the cost of living and reach a working basis for action. The commission had laid down four absolute essentials of decent self-support: (a) respectable lodging; (b) three meals a day; (c) suitable clothing; (d) some provision for recreation, self-improvement and care of the health." Guided by these principles the board "made the same kind of inquiry which any individual seeking food, shelter and lodging is daily making." Their first tentative estimate, as stated in press reports totaled $8.71. This amount was later reduced to $8.28 as presented above. The process of reduction may be indicated by the statement that the laundry item was at first $.50 per week but finally stood at $.20 per week. The board found that lodging "at the lowest

*With this estimate may be compared usefully the detailed statement on pp. 47–65 of the report of the Industrial Welfare Commission of the State of Washington, 1914. The study was based on estimates of 112 wage-earners from four occupations, and estimates of 138 employers and the totals reached were as follows: (See p. 65.)

ESTIMATED TOTAL ANNUAL EXPENDITURES.

By employees	Number.	Amount.
Mercantile	51	$523.27
Factory	15	489.24
Laundry	14	499.27
Miscellaneous (office, telephone, etc.)	32	518.96
	112	
By employers	138	$535.10

level of decency cannot be found in Boston for less than $1.50 per week. A minimum cost for food is at least $3.00 a week. If one has courage to go little beyond keeping warm and dry" clothing cannot be bought "for less than $45 a year, or $.87 per week. For the preservation of health, average expenditures of $8.75 per year, or 17 cents per week seem an irreducible minimum. Carfare requires at least $.60 a week." The budget so built up totals $6.14. To this irreducible minimum the board then added 50 cents per week for food and lodging; 48 cents per week for clothing; and additional items as shown in the table. In conclusion the board reported that $8.28 per week was not "a true living wage" since "it makes no allowance for savings or insurance." Allowing for variation between individuals, the wage board is convinced that the sum required to keep alive and in health, a completely self-supporting woman in Boston is in no case less than $8.00, and in many cases may rise to $9.00 or more." This modest estimate may be compared with the $10.60 reached by the 30 social workers and the $10.00 derived from Miss Bosworth's study.

The studies made in St. Louis and Kansas City, Missouri, are in close agreement in all items except that in St. Louis, 50 cents more is allowed for food, while in Kansas City practically the same sum is included in the more liberal allowance for "incidentals, sickness and unemployment." The St. Louis study was made by Miss Ruth Crawford as a part of a report made to the Senate Commission on Minimum Wage and is based on detailed schedules furnished by 50 working women from occupations fairly representative of the city's female wage-earners, supplemented by a study of the four lodging house districts. The study in Kansas City was made by the Bureau of Labor Statistics in the Board of Public Welfare in that city. It was compiled by an investigator for the bureau after "interviewing about 3,000 working girls." The report concludes; "This estimate is a very conservative one, and, in view of the time frequently lost because of unemployment and sickness, very little would be left for luxuries."

The remaining estimates,* those from Minnesota, are the

*These estimates were furnished through the courtesy of Eliza P. Evans, an efficient member of the Minnesota Minimum Wage Commission.

totals reached after consideration in three wage boards. The items presented in the tables are those adopted by various subcommittees of the wage boards. The Twin City Mercantile Board failed, after two attempts, to get a majority vote on a recommendation for a minimum wage to the Minimum Wage Commission. The Wage considered in these attempts varied from $7.50 to $8.75. The Twin City Manufacturing Board recommended $8.75 a week as a minimum wage for workers of "ordinary ability." The Duluth Board reached substantial agreement at $8.50 per week. This, it will be noted, is somewhat below the total of the estimates of the subcommittees. Such action by substantial majorities of committees composed of persons intimately associated with the industry in question should go far in support of the conclusion that $8.50 per week is the practical basis for action in fixing living wages.* With this conclusion the estimates of St. Louis, Kansas City, and the Massachusetts Wage board closely agree.

Moreover, comparison of the most important items in the table will show substantial agreement in the majority of estimates. Thus, the cost of food, in the majority of cases, falls within the limits of $3.00–$3.50; of rent, within $1.50–$2.00; and of clothing, within $1.50–$2.00. Carfare is usually put at 60 cents; laundry from 25 to 50 cents; medical expenditures from 20 to 40 cents. The largest amount of variation comes in the attempts to estimate such items as amusement, vacation, education, etc. Mention should be made of the failure in all cases, save one, to include any allowance for unemployment. Since studies of wages show that the average wage-earning female loses 10 per cent. of possible working time through loss of days within the week and perhaps as much more through loss of weeks in the year,† a true living wage would necessarily include some provision for this contingency. All in all, the estimates show a substantial advance toward uniformity. This is particularly true if attention is focused on the later estimates and those made as a basis for the fixing of actual minimum wage scales.

*See the writer's paper in the *Quarterly Journal of Economics*, February, 1915.

†*Ibid.*, p. 209, et seq.

Such legal minimum wages have been fixed in five states:* In Utah by statute; in Washington, Oregon, Minnesota, and Massachusetts through the orders of wage boards and commissioners. The Utah scale covers female workers and provides: "for minors under the age of 18, not less than 75 cents a day; for adult learners and apprentices, not less than 90 cents a day; provided that the learning period or apprenticeship shall not extend for more than one year; for adults who are experienced in the work they are employed to perform, not less than $1.25 per day."

The Washington Commission has ordered minimum weekly wage rates for adult females of $10.00 in mercantile establishments; of $9.00 in laundries, dye-works, telegraph and telephone companies; and of $8.90 for factories. For wage-earners under 18 years of age, of both sexes, the minimum weekly wage rate is $6.00. It is provided in the case of mercantile establishments that apprentices shall be paid not less than $6.00 per week during the first six months, and not less than $7.50 per week during the second six months.

The Industrial Welfare Commission of Oregon has ordered that wage rates for experienced adult women in Portland shall be: $9.25 per week in mercantile establishments; $8.64 per week in manufacturing establishments; and $40.00 per month for office workers. The minimum wage rate for such experienced adult workers in all the industries of the state is fixed at $8.25. Inexperienced adult workers may be paid at the rate of $6.00 per week for a maximum period of one year. A minimum rate of $1.00 per day for girls between the ages of 16 and 18 years is established. The rate of $8.64 for women engaged in manufactures has been unanimously sustained by the Supreme Court of Oregon and is at present before the Federal Supreme Court, on appeal from this favorable decision.

The first Minnesota orders were issued in November, 1914. The general minimum for women and minors of ordinary ability was fixed at $8.00, with higher rates as shown below:

*The statement for Utah is quoted from a copy of the law; in Washington, Oregon, and Minnesota the statement is drawn from the printed orders of the Commission; and the Massachusetts order is found in Bulletin No. 3 of the Minimum Wage Commission.

	Cities 1st class	Cities 2nd, 3d, 4th class.	Elsewhere in state.
Mercantile, offices, waitresses, or hair-dressing occupation.....	$9.00	$8.50	$8.00
Manufacturing, mechanical, telephone, telegraph, laundry, dyeing, dry-cleaning, lunch-room, restaurant or hotel ..	$8.75	8.25	8.00

It is stated that the orders do not apply to learners and apprentices. The orders are at present suspended, due to an adverse decision in the District Court of the State on the question of their constitutionality.

The only Massachusetts order so far issued applies to the brush-making industry and sets a minimum wage for experienced female employees of 15½ cents an hour. "Assuming an average scale of 50 hours and regular employment, this rate would yield earnings of $7.75" and is thus a conservative ruling. Learners and apprentices are to receive 65 per cent. of this rate as a mimimum and the period of apprenticeship is not to be longer than one year.*

Consideration of the various estimates of the costs of living, and of the various wage orders, due allowance being made for the greater or less expenses connected with various occupations, for the higher costs in the larger cities and the remoter states, and for the varying standards of workers, justifies the conclusion that a working basis for a living wage in the American states is $8.50. As a general statement, $7.00 per week would represent the cost at the subsistence level, an irreducible minimum; and $10.00 the estimated cost where exceptional demands are made on the wage-earner, where expenses are exceptionally high, or where an exceptionally liberal standard is in view.

*A useful summary of these wage orders may be found in the First Biennial Report of the Industrial Welfare Commission of the state of California, pp. 21-22.

THE IMPROVEMENT AND EXTENSION OF THE REGISTRATION AREA.*

By Louis I. Dublin, Ph. D., *Statistician, Metropolitan Life Insurance Company, New York.*

It is my purpose to present the point of view of the public, and especially of the private organizations, in this symposium.

Let me define at the outset what I believe is the attitude of these groups toward this problem. Their chief interest in furthering national vital statistics is to conserve life and health. There are evidences of gross waste in infant life, in early life from preventable infection, and in middle life from the degenerative diseases. There is concern that the new generation is perhaps too largely represented by the offspring of the racial stocks less favored economically, physically, and spiritually. The public has become aware of these conditions not so much through statistical inquiries as through direct observation. Its knowledge is still largely a matter of personal impression. It is now desired to learn the extent of this waste accurately, to locate it definitely, to discover its causes, and to apply suitable remedies. The nation wants the facts. A complete system of vital statistics is the only way to get them.

The contribution of the federal government to this demand for adequate statistical material is a registration area for deaths, covering, up to the present time, about two thirds of the population of the country. A registration area for births exists only as a plan, and an area for reporting disease has not even been seriously contemplated.

The time is opportune for the improvement and extension of the registration service. The public, when properly approached, has responded favorably upon several occasions. In the course of the last two years at least five states—Arkansas, Tennessee, North Carolina, South Carolina, and Georgia—after a campaign of education among the people, have adopted the Model Vital Statistics Law approved by the Bureau of the

*Read at the annual meeting of the American Statistical Association, Princeton, N. J., December 30, 1914.

Census. A number of other states have accepted amendments bringing their statutes into closer agreement with the provisions of the model bill. It is important to note that the social workers and those especially interested in public health are the moving spirits in this educational work. The registration area has been largely extended through the efforts of those fighting for improved infant hygiene, for the control of tuberculosis, and for better working conditions for men and women in industry. The statisticians have played only a subordinate part in these campaigns.

Private organizations are vitally interested in the campaign for better registration. The railways, the telephone and telegraph companies, the large industrial corporations, the life insurance companies—indeed, all public service agencies whose field of operation covers a large part of the country—are concerned with the conditions of life and health of the population. The extension of their markets is often determined by sanitary and hygienic considerations. In addition they are becoming more and more interested in the welfare of their employees. They desire to know the facts of mortality and morbidity as experienced by the men in their plants. Many have accordingly established statistical departments, through which they keep themselves informed as to conditions both within and without their plants. These statistical offices are for the most part ready to further the extension of the registration area.

It will be helpful at this point to refer briefly to what some of the private companies have done to improve vital statistics. Their activities may point out the way in which other organizations can coöperate. The Association of Life Insurance Presidents, for example, has circularized the country in the cause of better registration. It has urged the model bill in many states, has been represented at legislative hearings in behalf of this measure, has held public sessions on the value of statistics, and has given wide publicity to these meetings. A number of individual companies have acted on their own initiative. The agency force of one organization regularly sends to the registrars notices of births occurring among policyholders. This company has distributed to physicians, to legislators, to

women's clubs, and to other groups whose coöperation might be helpful, thousands of pamphlets on the uses of vital statistics. It has advocated the Model Vital Statistics Bill in a number of states, and has asked its agency force and medical examiners to write to their representatives urging this advanced legislation. Still other organizations will be glad to serve in this campaign.

The movement for better vital statistics is suffering, however, from a lack of cohesion among its advocates. What is needed is a central office which will inspire and direct cooperation among the various public and private organizations. This central office should serve as a clearing house for all interested bodies. Its director should be well acquainted with the difficult problems which confront registrars in the states; he should, moreover, inspire confidence among statistical workers throughout the country. If necessary, this central office should be independent of government control, and privately endowed, like so many other philanthropies which have sprung up in recent years to fulfil some noteworthy public function. This is a matter of concern to the members of the American Statistical Association and of other organizations interested in the extension and improvement of the registration service.

Logically, this central office for registration propaganda should be within the Bureau of the Census itself. No other agency occupies so favorable a position both in its organization and in its traditions. The Bureau of the Census has in the past appreciated the importance of this aspect of its work. The former chief statistician of the division of Vital Statistics was a missionary to whose efforts much of the extension of the registration service is due. No one else has mastered the practical difficulties of the problem as he did. His coöperation was always at the disposal of the several states that needed him; his work bore fruit and gave early promise of a nation-wide Registration Area. Today the Bureau occupies no such position of vantage in the movement. It is this which gives us such concern, and which, as I understand it, is the chief occasion for this symposium.

If the Bureau of the Census is to maintain its best traditions

as the organizer and as the repository of national vital statistics, it must satisfy a number of exacting conditions.

First: It should be ready to coöperate with state registration officials. Because of the constitutional limitations placed upon the federal service, the Bureau can obtain the fundamental data on mortality only through the courtesy of the states. It would do well, therefore, to endeavor to serve the states in the solution of their registration problems. To this end, the Bureau must have at its disposal a number of active and expert agents whose function shall be to act as consultants to state registrars, especially in the non-registration states. The cordial relations with the states must be maintained as a primary condition of effective service. At the same time there must be a harmonious plan for the transcription and forwarding from the states of the primary documents used by the federal service. The recent administrative ruling of the Director of the Census, reversing the former method of obtaining transcripts, very nearly resulted in the disruption of the Registration Area.

Second: The Bureau of the Census must be entirely non-partisan. Changes in national administration should not, as a matter of course, involve changes in directors, with the inevitable upheaval in policy and practice which these occasion in the Bureau. The work of this office is essentially scientific and technical in character. Experience should count as a chief consideration. The displacement of tried and efficient chiefs of division is, therefore, subversive of Bureau efficiency. Nor should political considerations be allowed to interfere with the accuracy of Census returns. Demands for padded population counts and for the publication of mortality rates in such a form as would make sanitary conditions appear better than they really are should receive no encouragement whatever from the Census Bureau. This office must always stand out as the exponent of truth, whatever the cost may be.

Third: The Bureau of the Census should encourage and guide public and private organizations in their statistical work. Industrial establishments and philanthropic institutions of all sorts are collecting vital statistics, the tabulation and the publication of which would prove of much greater value if they

were carried on in accordance with the standard practice of the Bureau. A well-directed effort toward this end would probably result in standardizing the compilations of the hospitals and sanatoria, the visiting nurse associations, and especially the life insurance companies. These last institutions—particularly the large industrial companies—possess a wealth of most useful data on mortality, which could readily be made to supplement the reports of the Bureau of the Census. Indeed, the record of their mortality experience in the non-registration states would prove to be the very best available measure of the sanitary conditions of these sections.

Fourth: The Bureau of the Census should become more active as an educational agency in the dissemination of statistical knowledge. Much of the material prepared by the Bureau, if properly analyzed and edited for the press, would prove of the greatest public interest. Such contributions would be especially helpful in furthering the movements for better hygiene and sanitation throughout the country. They would also result in increasing the amount of statistical instruction in our schools and colleges. This policy would leave a very definite impression upon the mental attitude of the people toward statistics, and the demand for better and wider registration would not be so easily denied or ignored by our States. In this way the foundation would be laid for nation-wide vital statistics.

In conclusion, let me say that the chief requirement at this time for the improvement and extension of our registration service is a better appreciation, by those who are directing the statistical work of the states and of the federal government, of the fact that they have in their hands the key to the solution of some of our most vexing problems.

OSCULATORY INTERPOLATION FORMULAS.

By C. H. Forsyth, *Ann Arbor, Mich.*

The best formulas of interpolation, making use of finite differences, are Newton's, Everett's, Stirling's, and Bessel's which are as follows:

Newton's formula:

$$u_x = u_0 + x\Delta u_0 + \frac{x(x-1)}{2!}\Delta^2 u_0 + \frac{x(x-1)(x-2)}{3!}\Delta^3 u_0 + \cdots.$$

Everett's formula:

$$u_x = f(\xi)u_0 + f(x)u_1$$

where $f(x) = x + \dfrac{(x+1)^{(3)}}{3!}\delta^2 + \dfrac{(x+2)^{(5)}}{5!}\delta^4$

$$= \left(x + \frac{(x+1)x(x-1)}{3!}\delta^2 + \frac{(x+2)(x+1)x(x-1)(x-2)}{5!}\delta^4\right)$$

and ξ is the distance of u_x measured behind u_1.

Stirling's formula:

$$u_x = u_0 + n\bar{\delta}u_0 + \frac{n^2}{2!}\delta^2 u_0 + \frac{n(n^2-1)}{3!}\bar{\delta}^3 u_0 + \frac{n^2(n^2-1)}{4!}\delta^4 u_0 + \frac{n(n^2-1)(n^2-4)}{5!}\bar{\delta}^5 u_0 + \cdots.$$

Bessel's formula:

$$u_x = u_0 + n\delta u_{\frac{1}{2}} + \frac{n(n-1)}{2!}\bar{\delta}^2 u_{\frac{1}{2}} + \frac{n(n-1)(n-\frac{1}{2})}{3!}\delta^3 u_{\frac{1}{2}} + \frac{n(n^2-1)(n-2)}{4!}\bar{\delta}^4 u_{\frac{1}{2}} + \frac{n(n^2-1)(n-2)(n-\frac{1}{2})}{5!}\delta^5 u_{\frac{1}{2}} + \cdots.$$

Thus Newton's formula is based upon ordinary differences and the three others upon central differences whose notation is explained by the following table:

$$
\begin{array}{lllll}
u_{-2} & & & & \\
 & \delta u_{-\frac{3}{2}} & & & \\
u_{-1} & & \delta^2 u_{-1} & & \\
 & \delta u_{-\frac{1}{2}} & & \delta^3 u_{-\frac{1}{2}} & \\
u_0 & & \delta^2 u_0 & & \delta^4 u_0 \\
 & \delta u_{\frac{1}{2}} & & \delta^3 u_{\frac{1}{2}} & \\
u_1 & & \delta^2 u_1 & & \delta^4 u_1 \\
 & \delta u_{\frac{3}{2}} & & \delta^3 u_{\frac{3}{2}} & \\
u_2 & & \delta^2 u_2 & & \\
 & \delta u_{\frac{5}{2}} & & & \\
u_3 & & & &
\end{array}
$$

We shall use the central difference symbols but with a dash over them to designate the arithmetic averages of the differences of the same order on both sides of them. Thus $\bar{\delta} u_0 = \frac{1}{2}(\delta u_{\frac{1}{2}} + \delta u_{-\frac{1}{2}})$, and so on for the rest. We believe that this latter idea is an improvement over that of Mr. Sheppard,* who contrived the scheme of representing central differences shown in the above table, in which a separate character μ is introduced instead of the dash which we suggest. We consider the use of the character μ in such a way to be very misleading.

The purpose of this paper is threefold. First we wish to give the results of our derivations of the osculatory formulas based upon Stirling's and Bessel's formulas corresponding to those which have been derived based upon Newton's† and Everett's‡ formulas, all to be used for interpolating four values between two of a series of equidistant values by fifth differences. Second, we wish to bring together all four osculatory formulas for purposes of comparison and future reference. Third, we wish to offer for future reference formulas for computing fifth leading differences to be used in connection with the applications of the four osculatory interpolation formulas, to simplify the computation when several successive intervals are to be considered.

As is well known, all interpolations within a series of successive intervals are performed through the use of a series of

* Proceedings of the London Mathematical Society, Vol. XXXI, p. 449.
† Journal of the Institute of Actuaries, Vol. 22., p. 270.
‡ J. I. A., Vol. 42, p. 369.

what might be called partial interpolation curves. In osculatory interpolation, the "joints" of these separate interpolation curves are welded together in a more satisfactory manner by requiring that not only the slopes but also the curvatures of any two interpolation curves to be the same at their point or points of intersection. Thus the two interpolation curves, one through the points u_{-2}, u_{-1}, u_0, u_1, and u_2, the other through u_{-1}, u_0, u_1, u_2, and u_3 are required to have equal slopes and equal curvatures at the two points u_0 and u_1 for purposes of interpolating any number of values (four, in this paper) between u_0 and u_1. This modification tends to remove the discontinuities usually found at the intersections of two distinct interpolation curves.

This method of interpolation has been termed "osculatory" interpolation because the successive pairs of partial interpolation curves are thus seen to have a common osculating circle at their points of intersection. It was first devised by Sprague* and later developed and applied by Karup,† King,‡ Buchanan,§ and others.‖ The method or rather modification has already been applied to Newton's* and Everett's§ formulas, the latter of which involves only even central differences of each of the middle pairs of the series of values between which the interpolations are to be made. The central difference formulas, Stirling's¶ and Bessel's, are so widely used that it seemed well worth while to obtain the osculatory formulas for them as well as for Newton's and Everett's formulas.

The process of deriving the osculatory formulas wherein analytically first derivatives are considered in lieu of slopes and second derivatives in lieu of curvatures has been explained so well in connection with the derivation of Sprague's formula (based upon Newton's formula) and Buchanan's formula (based upon Everett's formula), and especially in an independent note by Lidstone**, that we shall give simply the final

* Journal of the Institute of Actuaries, Vol. 22, p. 270.
† Trans. Second International Actuarial Congress, p. 78.
‡ J. I. A., Vol. 42, p. 225.
§ J. I. A., Vol. 42, p. 369.
‖ Quarterly Pub. Amer. Stat. Assoc., June, 1910.
The Record. Amer. Inst. of Actuaries, June, 1911.
¶ Text-book. Institute of Actuaries, p. 447.
** J. Inst. Act., Vol. 42, p. 394.

equations of the two curves. The one based upon Stirling's formula becomes

$$u_x = u_0 + x\bar{\delta}u_0 + \frac{x^2}{2}\delta^2 u_0 + \frac{(x^3-x)}{3!}\bar{\delta}^3 u_0 + \frac{(x^4-x^2)}{4!}\delta^4 u_0 + \left(\frac{x^5}{20} - \frac{x^3}{4} + \frac{x}{5}\right)\frac{\bar{\delta}^5 u_0}{3!} \tag{1}$$

The equation based upon Bessel's formula becomes

$$u_x = u_0 + x\delta u_{\frac{1}{2}} + \frac{(x^2-x)}{2}\bar{\delta}^2 u_{\frac{1}{2}} + \left(x^3 - \tfrac{3}{2}x^2 + \frac{x}{2}\right)\frac{\delta^3 u_{\frac{1}{2}}}{3!} + \frac{(x^4 - 2x^3 - x^2 + 2x)}{4!}\bar{\delta}^4 u_{\frac{1}{2}} + \frac{(-x^5 + 2x^4 - x^3)}{4!}\delta^5 u_{\frac{1}{2}} \tag{2}$$

If we substitute successively $x = \frac{0}{5}, \frac{1}{5}, \cdots, \frac{5}{5}$ in equations (1) and (2), and difference each of the sets of six results five times we obtain the two desired sets of leading differences for interpolating four values between u_0 and u_1.

The osculatory leading differences based upon Stirling's formula are:

$$\begin{array}{lccccccccc}
(1) & \frac{\bar{\delta}u_0}{5} & + \frac{1}{2}\frac{\delta^2 u_0}{5^2} & - 4\frac{\bar{\delta}^3 u_0}{5^3} & - & \frac{\delta^4 u_0}{5^4} & + & \frac{\bar{\delta}^5 u_0}{5^4} \\
(2) & & 1\ \text{“} & +1\ \text{“} & -\frac{3}{2}\ \text{“} & & +3\ \text{“} & \\
(3) & & & 1\ \text{“} & +\frac{3}{2}\ \text{“} & & -3\ \text{“} & \\
(4) & & & & 1\ \text{“} & & -2\ \text{“} & \\
(5) & & & & & & 5\ \text{“} &
\end{array} \tag{A}$$

The osculatory leading differences based upon Bessel's formula are:

$$\begin{array}{lccccccccc}
(1) & \frac{\delta u_{\frac{1}{2}}}{5} & - 2\frac{\bar{\delta}^2 u_{\frac{1}{2}}}{5^2} & + & \frac{\delta^3 u_{\frac{1}{2}}}{5^3} & + & \frac{9\bar{\delta}^4 u_{\frac{1}{2}}}{5^4} & - \frac{2}{15}\frac{\delta^5 u_{\frac{1}{2}}}{5^4} \\
(2) & & 1\ \text{“} & -\frac{3}{2}\ \text{“} & & -4\ \text{“} & & -\frac{1}{3}\ \text{“} \\
(3) & & & 1\ \text{“} & & -1\ \text{“} & & +\frac{1}{2}\ \text{“} \\
(4) & & & & & 1\ \text{“} & & +0\ \text{“} \\
(5) & & & & & & & -1\ \text{“}
\end{array} \tag{B}$$

The osculatory leading differences derived by Buchanan, based upon Everett's formula are:

$$
\begin{array}{lccccccccc}
(1) & -\frac{u_0}{5} & -6\,\frac{\delta^2 u_0}{5^3} & +8\,\frac{\delta^4 u_0}{5^4} & +\frac{u_1}{5} & -4\,\frac{\delta^2 u_1}{5^3} & + & \frac{\delta^4 u_1}{5^4} & & \\
(2) & & 4 & " & -7 & " & +1 & " & +3 & " \\
(3) & & -1 & " & +2 & " & +1 & " & -3 & " \\
(4) & & & & 3 & " & & & -2 & " \\
(5) & & & & -5 & " & & & +5 & "
\end{array}
\qquad (C)
$$

The osculatory leading differences derived by Sprague, based upon Newton's formula are:

$$
\begin{array}{lccccccccc}
(1) & \frac{\Delta u_0}{5} & +8\,\frac{\Delta^2 u_0}{5^2} & +11\,\frac{\Delta^3 u_0}{5^3} & -11\,\frac{\Delta^4 u_0}{5^4} & + & \frac{\Delta^5 u_0}{5^4} & & & \\
(2) & & 1 & " & +6 & " & +1 & " & +3 & " \\
(3) & & & & 1 & " & +4 & " & -3 & " \\
(4) & & & & & & 1 & " & -2 & " \\
(5) & & & & & & & & 5 & "
\end{array}
\qquad (D)
$$

To apply these different sets of leading differences, the observed series of values are differenced as usual, the differences averaged wherever necessary in connection with the central differences and finally each difference divided by the appropriate power of 5 (or multiplied by the corresponding decimal). The leading differences themselves are then formed according to the above tables. Each group of six original values will have its own set of differences for interpolating four values between the inmost pair, but if a series of successive intervals are to be interpolated the best plan is to interpolate the first interval as outlined above and then compute merely the appropriate fifth leading differences for the succeeding intervals such that by continued summation or addition to the preceding leading differences of lower order (in each case) the required interpolations will be obtained. The possibility of this plan has been pointed out before* and we shall merely carry it out as Buchanan has done in connection with his treatment of Everett's formula. Not being able to find the formula for computing these fifth differences in connection with Sprague's formula, we have derived these formulas for this case as well as for the osculatory formulas based upon

*J. I. A. Vol. 42, p. 285.

Stirling's and Bessel's and derived in this paper. The method of derivation is outlined by Buchanan in his paper. These formulas or corrections of fifth differences for all four osculatory formulas are as follows:

	Newton's		Everett's		Stirling's		Bessel's	
	$\frac{\Delta^5 u_0}{5^4}$	$\frac{\Delta^6 u_0}{5^4}$	$\frac{\delta^5 u_{\frac{1}{2}}}{5^4}$	$\frac{\delta^5 u_{\frac{3}{2}}}{5^4}$	$\frac{\delta^5 u_{\frac{1}{2}}}{5^4}$	$\frac{\delta^5 u_1}{5^4}$	$\frac{\delta^5 u_{\frac{1}{2}}}{5^4}$	$\frac{\delta^6 u_1}{5^4}$
(1)	$+4$	1	3	1	3	1	$-\frac{1}{2}$	$4\frac{11}{20}$
(2)	-6		-6		-6		3	$-15\frac{13}{20}$
(3)	-6	-6		-6		-6	$-\frac{1}{2}$	$17\frac{3}{10}$
(4)	4	3	1	3	1	3	$-1\frac{1}{2}$	$-6\frac{1}{2}$
(5)	5	5		5		5	-1	-1

The greatest disadvantage found in connection with the use of the above fifth differences is that usually the work should be carried to a greater number of decimals than if the above leading differences were used. If an appropriate computing machine is available this criticism is of no importance. As a general rule the work in connection with the leading differences should be carried to two more decimals than are to be finally retained and the work of the fifth differences to three or the maximum four.

One great advantage in the use of the above osculatory formulas is the accompanying check upon the computation, for the sets of leading differences not only lead to interpolations of the four values between a pair of intermediate original values but will also reproduce these original values and since the process of continued summation causes any errors in the computation to accumulate, such errors are readily caught.

Without going into the details, it should perhaps be pointed out that Bessel's and Everett's and hence the corresponding osculatory formulas lead to about the same degree of accuracy but are generally considered to be the most accurate of the four formulas considered in this paper. However, Everett's formula and the corresponding osculatory formula involve considerably less as well as simpler computation than Bessel's formula and its corresponding osculatory formula. The osculatory formula based upon Stirling's formula is very little less ac-

curate than those based upon Everett's and Bessel's formulas and is remarkably easy to apply although scarcely as easy as Buchanan's (that based upon Everett's). There is scarcely any justification in the further use of Sprague's osculatory formula since the derivation of the formulas for the other osculatory interpolations, leading as it does to results nowise as accurate and involving much computation.

In conclusion the following example is given to show the use of the above sets of leading differences. The following values of u are arbitrarily chosen and the corresponding differences found in the usual way as shown.

$u_{-2}=4673423$					
	13462				
$u_{-1}=4686885$		6321			
	19783		384		
$u_0=4706668$		6705		65	
	26488		449		13
$u_1=4733156$		7154		78	
	33642		527		
$u_2=4766798$		7681			
	41323				
$u_3=4809121$					

Here we have, for example, $\bar{\delta}u_0=\frac{1}{2}(19783+26488)$

The results after applying the four sets of leading differences are:

By (A)	By (B)	By (C)	By (D)	(C)−(A)	(C)−(B)	(C)−(D)
$u_0=4706668$	4706668	4706668	4706668	0	0	0
4711406	4711397	4711397	4711416	9	0	19
4716418	4716401	4716401	4716435	17	0	34
4721710	4721691	4721691	4721729	19	0	38
4727287	4727273	4727273	4727301	14	0	28
$u_1=4733156$	4733156	4733156	4733156	0	0	0

REVIEWS AND NOTES.

NOTE ON A CERTAIN USE OF FINANCIAL STATISTICS.

In the QUARTERLY PUBLICATIONS for September, 1914, p. 236, Professor Nearing has an interesting article, entitled "Service Income and Property Income," which makes use of various statistical reports, especially those of railroad and other public-service commissions. In addition to being interested in the subject, my attention was naturally attracted to the use made of data from reports of the New York Public Service Commission for the First District, with which my position makes me familiar. The following remarks relate primarily to this point.

On page 248 "a total compensation of $28,632,580, and a total payment of interest and dividends of $12,204,640" for the street railways of the district in question, which is substantially New York City, are cited for 1911, the reference being to Vol. II, p. 133 and p. 327 (instead of, as incorrectly printed, to pp. 133–326). Text Table 37, which is on page 133, consists of the totals for two years of the general table showing income (and surplus) statements for street railways. This is Table XVI, A, and in the 1911 volume is at page 390. The other reference is direct to general Table XII, C.

Rounded to thousands of dollars, income deductions and dividends of the operating street railways of New York City for 1911 were as follows:

	Thousands of dollars.
Interest on funded debt	7,828
Other interest	2,579
Rent of road and equipment	12,242
Other rent	1,127
Other deductions	416
Total deductions from gross income	$24,192
Net corporate income	$10,171
Dividends	$4,376

Professor Nearing's "property income" is the sum of the first and last items. But, on the face of the data, why is not substantially all the $24,192,000 of income deductions, as well as the dividends, counted as "property income"? The small qualification theoretically necessary on account of the inclusion of non-operating income and income from outside operations should have the same sort of effect upon dividends as upon net income. In fact the essential distinction between revenue deductions and income deductions is that the latter are payments for the use of property, while operating expenses consist of costs for materials and services currently consumed and of charges for maintenance of the fixed investment. It is

true that what is cost to the company is not necessarily return to the investor. As appears from the footnotes to the items in Table XVI, A, "Other deductions" consist almost entirely of sinking-fund payments and amortization of debt discount and expense. We may therefore throw out this item. Rents, however, are payments for the use of property. Doubtless a considerable maintenance element is included in "Other rent charges." But "Rent of road and equipment" is, as Professor Nearing could easily have ascertained, composed almost entirely of dividends and interest upon outstanding securities of lessor street-railway companies. In division B of Table XVI, at page 394, these details are set forth. The lessors of the Interborough Rapid Transit show $3,399,000 interest on funded debt and $4,200,000 dividends, $7,599,000 being thus accounted for out of the $8,106,000 paid by the Interborough. Lessees of the various B. R. T. companies show $454,000 interest on funded debt and $971,000 dividends, or $1,425,000, out of $2,313,000 to be accounted for. Interest on funded debt shown by lessees of the predecessor of the New York Railways was $554,000 and dividends $1,410,000, or $1,964,000 in all, that is, more than sufficient to account for the $1,810,000 distributed by the company in question, the difference being explicable by the different bases of credit and debit accruals as between lessors and the bankrupt lessee. Thus, Professor Nearing's property-income item should be increased by $10,988,000, or nearly doubled.

In view of the well-known tendency on the part of railroads to obtain capital through note issues, some of the "Other interest" items are also certainly worthy of examination. The facts may be ascertained by reference to the abstracts of the companies' individual returns contained in Part III of the volume in question.* Substantially all the $1,596,000 thus charged by Brooklyn Rapid Transit companies is interest paid to the holding company which finances the requirements of its controlled street railways by means of demand notes. These are pledged as security for the mortgage indebtedness of the holding company. Altogether Professor Nearing's error of method is by no means insignificant in its effect on his statistics. His property income figure should be at least doubled.

The $28,633,000 for wages and salaries is not open to similar criticism. In this case lessor companies do not complicate matters. However, the amount includes wages charged to fixed capital and to that extent is not a regular annual charge. For this reason the ratio of "service income" to "property income" might better be determined by the study of a series of years.

The same remark applies to dividends. Even funded-debt interest was in an abnormal condition in New York City in 1911, when all the great surface roads of Manhattan and The Bronx were in the hands of receivers. This group of surface roads paid $1,080,393 in funded-debt interest in 1911, before the reorganization of the Metropolitan and Third Avenue railways, and $4,484,008 in 1913, after the reorganization. None of these companies paid dividends in either year.

* Pages 471, 482, 490, 523, 614, 375, and 690.

Professor Nearing also cites (on p. 249) data from vol. III of the 1911 Annual Report of the Public Service Commission for the First District. His reference is merely, in too large a way, to the volume as a whole. The two classes of income in question are stated for "gas companies," for the "electric companies," then for "companies operating both gas and electric franchises." For the last described group the figures given are: Total compensation, $16,850,676; total of interest and dividends, $19,443,164. These totals are somewhat larger than the sums of the figures previously cited. The difference may be accounted for by the three small gas-electrical companies. Reference to Table XXXVII at page 328 serves to verify the (funded-debt) interest and dividends, as stated for gas companies and for electrical companies separately. The combined figure, however, is peculiar in a way that will be explained shortly. The sub-group figures for compensation are similarly verifiable by reference to Table XXXI at page 262, except that the Flatbush Gas figure has not been deducted to obtain the "gas companies" figure and has been deducted to obtain the "electric companies" figure. Apparently the name of this company was allowed to mislead the compiler as to the fact of its being a gas-electrical company, though the evidence that it is such should have reached his consciousness through his use of data close at hand. The figure of total compensation is identifiable except for what is evidently an error of $1,000,000 in addition, transcription, or typography; that is, the total compensation to employees in the district, paid by gas, electrical, and gas-electrical companies appears in Table XXXI as $15,850,676. In addition to this, however, the Consolidated Telegraph and Electrical Subway, a conduit company, paid out $946,206 in compensation; and the Empire City Subway Company, $327,658.* The $1,000,000 mentioned above might have been intended to allow for wages paid by these conduit companies, most, but not all, of whose property is used by the electrical companies. But in that case one would expect the final figure also to be rounded, and verification of the process of obtaining it should have been facilitated by adequate references.

The $19,443,164 cited by Professor Nearing as interest and dividends appears to have been obtained by adding to the figures for gas companies and for electrical companies combined, the similar figures for gas-electrical companies, that is, funded-debt interest and dividends, and then—instead of stopping at this point as all his other corresponding figures do—further adding "Other interest," not merely for operating lighting companies, but the gross total of Table XXXVII, inclusive of electrical subway and non-operating companies. This procedure is unexplained and is, indeed, hardly explicable. Because of the interest of the question as to what kind of figures should have been taken for the purpose in hand, the figures of Table XXXVII are presented below on three possible bases (all amounts being in thousands of dollars):

* Cf. pp. 421 and 435 of the Report, Vol. III.

	Operating, Except Conduit, Companies	All Operating Companies	All Companies, Operating and Non-operating
Interest on funded debt	$4,851	$5,461	$5,690
Other interest	2,642	3,309	3,325
Rent for lease of gas or electric plant	1,632	1,632	1,632
Other rent	1,623	1,623	1,623
Other contractual deductions	12	12	12
Amortization of debt discount and expense	55	55	58
Total deductions	$10,815	$12,092	$12,340
Net corporate income	$22,715	$23,131	$24,113
Dividends	$11,267	$11,542	$12,342

It is impossible to obtain $19,443,000 by any combination of interest and dividends here shown, either according to the method of Professor Nearing's street-railway total or otherwise. It is also of fundamental importance that the figures above tabulated are for a group of companies largely associated with one another, with resulting inter-company payments of dividends, etc. In particular, the Consolidated Gas Company, in addition to being an operating company, is well known to be one of the most important holding companies in the country. The electrical subway or conduit companies have been already mentioned as deriving their income almost entirely from the revenues of the electrical companies. This is only more completely true of the non-operating companies. Hence the first column of figures in the above summary is, of the three, least subject to qualification on this account. The total of interest (on funded debt) and dividends obtained from it is $16,118,000.

But the Consolidated Gas Company had $5,731,000 of "Other income," not derived from gas operations, from which to pay dividends, and the New York Edison Company had similar income of $1,081,000. Consolidated system (incl. N. Y. Edison Co.) duplications are not to any appreciable extent due to leases of gas or electrical plants, hence the duplication cannot be eliminated by dealing with operating companies only and including as return on property rent paid to lessors, as is possible in the case of the street railways. But in fact the $1,632,000, "Rent for lease of gas or electric plant," in question is properly to be added to the operating-company interest and dividends because chiefly payable by the Edison Electric Illuminating (Brooklyn) to its lessor, as is explained in a footnote. This raises the $16,118,000 to $17,750,000, but without the Consolidated system duplications having been attended to. Because of this element in the situation it is impossible to get a satisfactory figure of the character sought without a detailed analysis of the income accounts of the various asso-

ciated companies. This is too large a task to undertake casually, and the data printed in the report are probably not sufficient to permit of its complete accomplishment. But it happens that something of the sort was attempted with the previous year's figures and the results appear in the 1910 Report, vol. IV, p. 97 ff. The Comparative Summary of Financial Data for 1910, unlike its successors, carries the process of deduction for duplications through the entire income and surplus accounts. Significant data therefrom are as follows:*

		1909.	1910.
Interest payable accrued on funded debt	Gross,	$6,738,675	$6,723,034
	Net,	5,650,625	5,572,806
Dividends paid	Gross,	9,480,231	10,663,751
	Net,	6,418,833	7,293,527
Combined	Gross,	16,218,906	17,386,785
	Net,	12,069,458	12,866,333

In these figures both subway and non-operating companies are included. The ratios of net to gross are as follows: 1909, funded-debt interest 83.85 per cent. and dividends 67.71 per cent.; 1910, funded-debt interest 82.89 per cent. and dividends 68.40 per cent. These per cents are nearly enough constant so that we may estimate the net figures for 1911 as 68 per cent. of gross dividends and 83 per cent. of gross funded-debt interest. This gives $8,393,000 dividends and $4,723,000 interest. To these should be added "Rent for lease of gas or electrical plant," $1,632,000, about half of the "Other interest," or another $1,600,000 and, finally, most of the "Other rent," paid to the subway companies, amounting to about $1,500,000. Altogether these amount to $17,850,000. That Professor Nearing's figure is only about $1,600,000 away from this figure is a mere accident.

Professor Nearing has touched a subject of great practical importance as well as of great statistical interest and difficulty. In order to do justice to both these viewpoints, however, it would seem to be necessary to treat the subject in a much broader way than he does. Broadly conceived, the problem is to determine what are the typical operating and financial ratios for each of the various branches of business. This is a matter of financial or accounting statistics. Data are as yet rather limited, though the exercise of the powers of the new federal trade commission should in time fill many of the gaps. But it is with Professor Nearing's procedure, not with his data, that fault must be found. The mere extraction from statistical reports of figures showing dividends and funded-debt interest paid in a particular year will not give a correct idea of return to property. A broader view of the disposition of revenues as a whole is necessary as a check upon, or qualification of, figures so obtained. In the volume of street-railway statistics cited by him, that is, in Table XV, F, for 1911,† Professor Nearing will find certain ratios presented, which show, among

* Page 100 of Vol. IV of the Commission's Annual Report for 1910.

† Page 388. Similar distributive ratios for gas and electricity can be found in the Vol. III. above referred to.

other things, that the operating street railways in that year paid (or accrued) for interest deductions an amount equal to 12.43 per cent. of their revenues; for rent deductions, 15.96 per cent.; and carried to the surplus account 12.14 per cent. Taxes accounted for 6.56 per cent. and operating expenses, for 54.92 per cent. of revenues. Other deductions took 0.50 per cent. The total of these items adds to more than 100 per cent. because the companies derived a net amount from other than street-railway operations equal to 2.51 per cent. of operating revenues. The extent to which compensation to officers and employees accounts for the 55 per cent. operating ratio is not shown in this table, because the classification of operating expenses does not keep such charges separate, though such procedure would certainly be highly desirable from a statistical viewpoint. The ratios stop with the surplus for the year, as does the income account. Theoretically this is practically all available for dividends. An intensive study of Professor Nearing's problem would have to consider just how far this view needs to be qualified in the long run. If a surplus is accumulated from undivided profits, is the property income less merely because profits are saved and reinvested by the corporation instead of being paid out to the stockholder, perhaps by him to be saved and reinvested? There is also the question as to whether depreciation has been adequately provided for before the figure of net income for the year is obtained. Still there remains the pervasive and evasive matter of intercorporate relations and their effects upon totals.

A statistical study of the sort Professor Nearing has undertaken requires careful attention to the economic and accounting relations that underlie the figures used. It is for lack of care in these respects, even more than for his too hasty use of sources that he is to be criticized.

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WHY DISTRIBUTIVE PERCENTAGES AS PUBLISHED IN THE REPORTS OF THE BUREAU OF THE CENSUS DO NOT INVARIABLY ADD TO 100.

In an article contributed to the December issue of the Quarterly Publications, the Bureau of the Census is stigmatized as guilty of "carelessness" or "slovenliness" because of the fact that in the reports of that Bureau, distributive or constituent percentages do not always add to 100.0. The Bureau was well aware of this fact. It results from a deliberate policy which it seems necessary to explain now that it has been made the subject of public criticism, even though the explanation is a matter of very elementary mathematics. Persons interested in the question may then judge for themselves whether the practice of the Bureau is right or wrong.

In Census work, percentages are expressed with decimal remainders carried out to one place. Thus the percentage which 125 is of 1000 would

be expressed as 12.5. Usually, however, percentages so expressed are not, as in this instance, exact. They are approximations and being approximations they will not invariably add to 100.0 unless they are adjusted so as to make them add to that. A simple illustration will show this. Take the following in which each item is exactly one-third of the total:

Items.	Amounts.	Per Cent. of Total.
A.....	422	33.3
B.....	422	33.3
C.....	422	33.3
Total.....	1,266	100.0

Here the percentages add to 99.9, yet each percentage is as nearly exact as it can be when carried out to only one decimal place. If, in order to make these percentages add to 100.0, one of these percentages is changed to 33.4 it becomes less exact than it was before, the exact percentage in each instance being nearer 33.3 than 33.4.

Although the constituent percentages in the above example add to 99.9 the percentage for the total is nevertheless given as 100.0 mainly for the reason that 100.0 is the true percentage and absolutely exact. It is just what it purports to be, viz., the percentage which the total is of the total. Furthermore, expressed as 100.0, it has the practical advantage of indicating to the reader that the percentages given above are the percentages which the items form of the total, 1266.

In view of this fact that percentages which have been adjusted so as to add to 100.0 are less exact than they were before the adjustment was made the Bureau of the Census some years ago deliberately abandoned the practice of adjusting percentages. Incidentally, however, the change was in the interests of economy as well as accuracy, for when, as is so often the case in census work, a large number of items are given, the adjustment, which must be made according to prescribed rules, involves considerable clerical labor.

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MECHANICAL DEVICES IN EUROPEAN STATISTICAL WORK.

To those familiar with the development of statistical methods it is well known that the introduction of mechanical devices for performing the clerical work has been one of the important factors in extending the range and improving the quality of the results in recent years. Not only is accuracy improved, due to the fact that machines do not make mistakes, a point in which they differ in an astonishing degree from the human organism, but of equal or greater importance is the extension in the quantity and complexity of statistical work which the mechanical methods

make possible, the mere labor of which would have been out of the question under hand tabulation and computation. In view of the lead taken by the United States in this branch of work, which may be called an American contribution, and of the fact that so many of the devices have been the product of "Yankee ingenuity," some data on the increasing use of such appliances in Europe may be of interest. Two circular inquiries sent out by the *Deutsches Statistisches Zentralblatt* * of Berlin to the various statistical bureaus and offices of Europe, one at the beginning of 1910 and the other at the beginning of 1914, have brought together some fairly complete figures. The following table, collated and condensed from this journal, shows the progress in the four years, amounting to nearly a doubling of the number of machines of all types in use.

NUMBER OF MACHINES BY CLASSES IN EACH COUNTRY.

Country.	Tabulating and Counting Machines.		Adding Machines.		Computing Machines.		Computing Cylinders, Tables, etc.	
	1910.	1914.	1910.	1914.	1910.	1914.	1910.	1914.
Austria	10	10	39	53	34	33	7	19
France	25	25	1	1	1	1	3	.....
Germany	.....	9	52	102	96	132	19	79
Luxemburg	.....	.....	.....	1	5	5	.....	.....
Belgium	.....	.....	2	1	1	1	1	1
Holland	.....	.....	4	7	2	2	.....	1
Switzerland	.....	.....	6	16	3	14	5	8
Sweden	.....	.....	1	1	3	4	.....	.....
England [1]	.....	.....	.....	.....	(4)	.....	(3)	.....
Denmark	.....	1	.....	4	.....	9	.....	8
Norway	.....	1	.....	.....	.....	2	.....	4
Totals	35 [2]	46	105	186	145	203	35	120
Grand Total	.....	.....	.....	.....	.....	.....	319	555

[1] Figures for England are omitted from the totals, no reports from that country having been received for 1914.

[2] See text below.

The numbers in the table are the totals of all appliances in use in each country by the various official bureaus engaged in statistical work, whether national, district, or municipal. A brief indication of the character and origin of the devices included in each class (also taken from the *Zentralblatt*) will make the table more intelligible. Reference is made to the figures for 1914. The machines referred to in the first column include three types. The 10 in use in Austria are the old style Hollerith electrical tabulating machine, invented by the American engineer of that name and first used in tabulating the results of the Eleventh Census of the United States. They indicate by means of clock dials and do not add or print. The 11 machines in Germany, Norway, and Denmark are the improved

*See *Deutsches Statistisches Zentralblatt*, 1910, columns 117, 151, 219; 1911, column 25; and 1914, column 233.

Hollerith type, printing automatically both sub-totals and totals.* The figures given include only the tabulating machines proper, and not the complement of punching and sorting machines. A total of 402 of the latter were in use.

The 25 machines ascribed to France are of the type called *classicompteur imprimeur*, designed by M. Lucien March, the head of the statistical work of the French government, and, so far as indicated, not used elsewhere. The device serves the same general purpose as the Hollerith machine, but differs much less from hand methods. It may be described as virtually a multiple counting machine with 60 sets of rolls and as many keys, one to each set. Depressing any key counts one on the corresponding set of number discs. The keys are named arbitrarily according to the data to be recorded, either a fact or a combination of facts; for example, in population tabulation, one key might represent "males," another, "native-born males, 20–30 years," or the like. For recording more than 60 separate facts or combinations, more than one machine is used. The totals are printed at any time, by depressing a lever, and the counters all reset at zero.

The second column gives the figures for the adding machines, which are familiar in every American business office, and require little comment. Of the total of 186 reported in use in the different countries, 153, or nearly five sixths, are distributed among the following American makes: Burroughs, Comptograph, Comptometer, Comtator, Standard, and Wales. Nearly all of these print automatically, both the numbers added and the totals. The remaining 23 machines represent 10 different styles, partly foreign, partly "origin not indicated," and largely small, inexpensive, non-printing devices.

But if America may be said to have practically preëmpted the field in the first two types of instruments, the reverse is the case with the last two varieties. The "computing machines" are designed to perform all four of the fundamental arithmetical operations, but are chiefly used for multiplication and division. They all depend on the basic principle of repeated additions for multiplication and repeated subtractions for division. The 203 machines are distributed among 20 makes, all apparently foreign to the United States, and represent two general systems of arrangement, the "Thomas" and the "Odhner." At least two patterns are imported and extensively used in this country, the "Brunsviga" and the "Millionaire." The latter is a Swiss product, arranged according to the "Thomas" system, but represents an improvement over all similar machines in that the repetition of the addition and subtraction operations to secure products and quotients is automatic, the result for each figure being obtained by a single turn of a single crank handle. None of these machines print.

* For a description of the early device, see the paper by Dr. Hollerith in the *Journal of the Statistical Society* for 1894, p. 678. Some description of the improvements introduced in connection with the Thirteenth Census of the United States will be found in the *Quarterly Publications of The American Statistical Asso.* for December, 1909, and a fuller, popular account in the *Scientific American* of September 11, 1909.

The devices classed in the fourth column of the table are a miscellaneous group of left-overs and include mainly slide-rules of different patterns and "tables" of various descriptions and systems.

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MORTALITY STATISTICS OF RECENT YALE GRADUATES.

Yale men are decidedly good mortality risks, especially during the years immediately succeeding graduation. This conclusion is indicated by the statistical analysis that is the subject-matter of this note. The contrary view expressed by Professor Newton of Yale, that college graduates exhibit a high death rate in the first years after graduation, would not seem to be borne out by a scrutiny of the mortality record of the twenty classes last graduated from Yale College.

These twenty classes, the first graduated in 1894 and the last in 1913, aggregated 5,870 men at graduation. Their aggregate mortality from time of graduation to 1914 was 266 men, an approximate annual average of 4.5 per 1,000 risks. The annual mortality rate for males of all ages throughout the United States (registration area) in 1900 was 18.91 per 1,000, and for males 25 to 34 years of age (corresponding roughly to the mean age of these college classes during the period under discussion) 9.05 per 1,000. It is clear that these twenty Yale classes present a better record by 50 per cent. than the average group of males of their age in the United States.

This might be expected, for college men are recruited among the mentally and physically virile, from whose ranks a continual elimination process during the college course weeds out the unfit. In other words, the college graduate has been subjected to a process of highly developed artificial selection. A fairer criterion by which to test these classes, therefore, would be the expected mortality of males of corresponding age according to the American Mortality Experience Table. This table was constructed some time ago, when the general mortality was probably more unfavorable than today; on the other hand, it was based upon a medically selected class of risks, practically all of them males, and is a recognized mortality standard for actuaries today.

According to the American Experience Table, the mortality among the 5,870 men who graduated from 1894 to 1913 would have amounted by 1914 to 480 men. The actual mortality, as we have seen, was 266, or only a little over one half the expected total.

The twenty classes show considerable variations in this respect, illustrating the fact that individuals and small social units frequently display different characteristics under substantially similar conditions. The following table gives the actual and the expected mortality of each class, and the percentage of actual to expected:

Class Yale College.	Number at Graduation.	Deaths to 1914.		Ratio of Actual to Expected Mortality Per Cent.
		Actual.	Expected.	
1894	238	27	38.5	70.1
1895	249	27	38.2	70.7
1896	278	20	40.3	49.6
1897	275	24	37.4	64.2
1898	300	21	38.8	54.1
1899	298	27	35.8	75.4
1900	320	18	35.7	50.4
1901	253	17	26.2	64.9
1902	291	9	27.8	32.4
1903	316	19	27.6	68.8
1904	286	4	22.6	17.7
1905	288	7	20.6	34.0
1906	295	17	18.7	90.9
1907	356	12	19.8	60.6
1908	339	8	16.1	49.7
1909	310	4	12.3	32.5
1910	310	3	9.8	30.6
1911	297	1	7.1	14.1
1912	286	1	4.5	22.2
1913	285	0	2.3	—
Total	5,870	266	480.1	55.4
Average	293.5	13.3	24.0	55.4

Variations in the ratio, as among the several classes, run all the way from zero in the latest class up to 90.9 per cent. in the class of 1906. It is difficult to analyze these variations, or to explain why classes that graduated within the same five-year period, such as the classes of 1904 and 1906, differ so greatly in their relative mortality records. One may only fall back upon the well established statistical principle that the law of social averages cannot be applied to individuals or even to small groups of individuals, owing to variations in individual type. But extend the inquiry over a larger number of individuals or groups, and the social law emerges above the individual variations in type. Thus the twenty classes when reduced to five-year groups display a uniform and constant tendency, as follows:

Groups of Classes.	Aggregate Number.	Aggregate Deaths to 1914.		Ratio of Actual to Expected Mortality. Per Cent.
		Actual.	Expected.	
1894–1898	1,340	119	193.2	61.6
1899–1903	1,478	90	153.1	58.8
1904–1908	1,564	48	97.8	49.1
1909–1913	1,488	9	36.0	25.0

Not only do the actual number of deaths decrease among the more recent classes, but the ratio of actual to expected deaths also decreases.

The decrease is constant throughout the four five-year groups, and is especially marked in the case of the last five classes. This seems in direct contrast to the conclusion of Professor H. A. Newton, already cited, (F. B. Dexter's Yale Biographies and Annals, 1896, Vol. 2, p. 785) that "it is a marked feature of the mortality statistics of American college graduates that there is excessive mortality in the years immediately following graduation, no doubt due to the strenuous efforts of young graduates to attain a good position in their profession, while the later favorable experience in the ages from 45 to 75 is presumably due to the fact that they have by that time gained position or else lost ambition."

This rather categorical statement was called to mind by the present writer in a note on the longevity of college graduates in the *Yale Review* for May, 1905, the statistics presented in that note seeming to bear out Professor Newton's contention. The statistics here set forth, however, run directly counter to his findings, and offer ground for further speculation and argument.

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NOTE.

Dr. Jacques Bertillon, who recently retired after long and distinguished service at the head of the municipal statistics of Paris, has now been asked by the French Minister of War to take charge of the French medical statistics of the war. The data for these statistics will be collected on individual schedules, of which 3,500,000 have already been printed and more will be needed. Thirty invalided soldiers are at work under him in classifying and counting the bulletins. The brilliant ability of Dr. Bertillon as a statistician promises to make the report, when published, one of the most authoritative sources for medical statistics in this field. Similar reports were published in France after the Crimean War and the Italian War of 1859. They were edited by a military statistician named Chenu*; but the data on which his works were based were fewer in number and more restricted in range of information than those upon which Dr. Bertillon's report will rest.

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* *Rapport au conseil de santé sur les résultats du service médico-chirurgical pendant la campagne d'Orient en 1854–1855–1856* (Paris, 1865). *Statistique médico-chirurgicale de la campagne d'Italie en 1859 et 1860* (Paris, 1869).